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ITFS, WHAT IT IS...HOW TO PLAN, INSTRUCTIONAL TELEVISION FIXED SERVICE.

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ITFS IS A PRIVATE DISTRIBUTION OF EDUCATIONAL TELEVISION IN WHICH PRESELECTED RECEIVING POINTS, LOCATED WITHIN 20 MILES FROM THE TRANSMITTER, ARE CONNECTED BY RADIO SIGNALS RATHER THAN BY CABLES. PLANNING FOR ITS USE REQUIRES CONSIDERATION OF ITS POSSIBILITIES AND ITS LIMITATIONS, ITS EFFECT UPON THE CURRICULUM AND LEARNING, DEFINITIONS OF OBJECTIVES THE SYSTEM IS TO SERVE, APPLICATION TO THE FCC FOR A CONSTRUCTION PERMIT, EMPLOYMENT OF AN ENGINEERING CONSULTANT WHO CAN HELP SELECT THE BEST AND MOST ECONOMICAL SYSTEM FOR THE SITUATION, AND DEVELOPMENT OF A STAFF WHICH SHOULD INCLUDE A TV COORDINATOR, A PROGRAMING STAFF, AND A TECHNICAL STAFF. COSTS TO BE CONSIDERED ARE SURVEY COSTS, TRANSMITTING EQUIPMENT COSTS, STUDIO EQUIPMENT COSTS, AND RECEIVING AND DISTRIBUTION EQUIPMENT COSTS. COOPERATIVE PROGRAMING CAN BE A MEANS OF COMBINING RESOURCES NATIONWIDE, THUS REDUCING COSTS. A LIST OF FCC DOCUMENTS ON ITFS IS INCLUDED WITH OTHER REFERENCES. THIS DOCUMENT IS AVAILABLE FOR $1.00 FROM PUBLICATION-SALES SECTION, NATIONAL EDUCATION ASSOC., 1201 SIXTEENTH ST., N.W., WASHINGTON, D.C. 20036. (CS)

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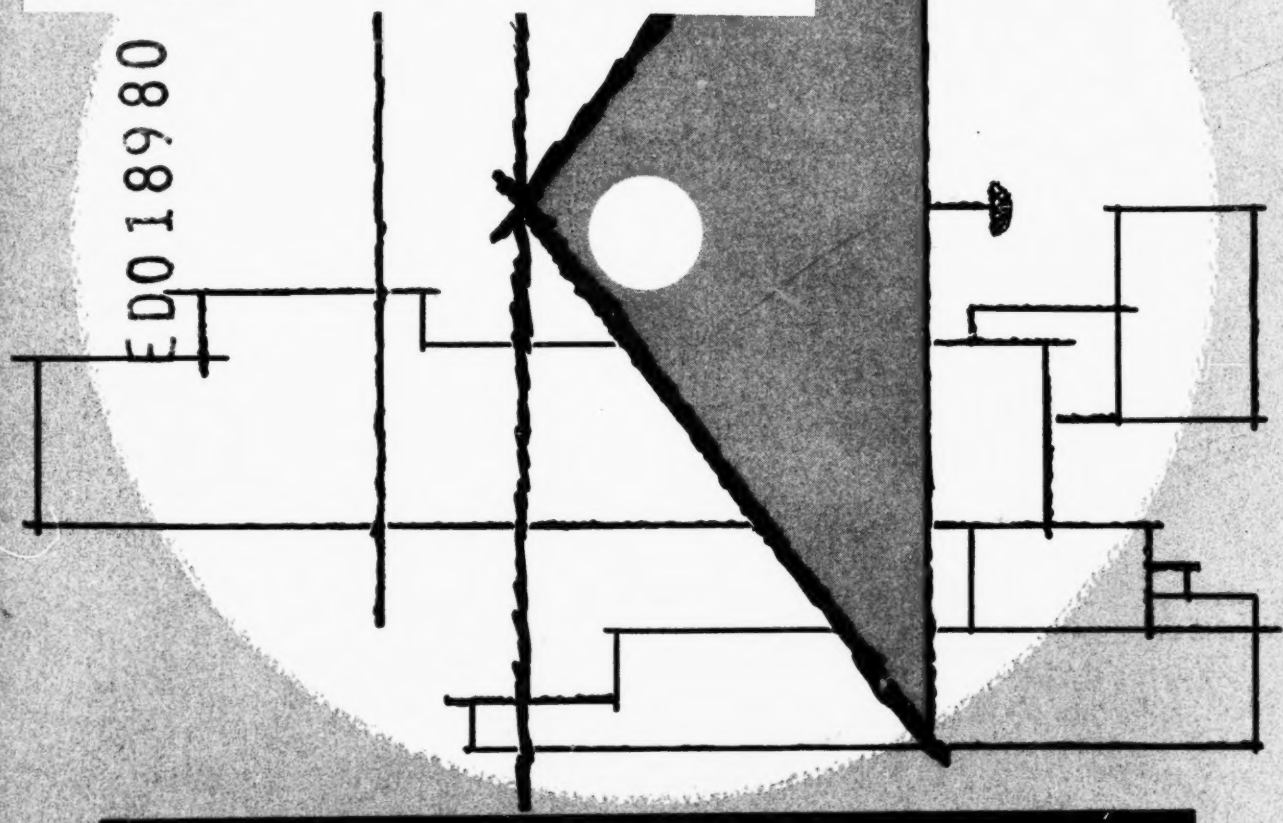

ITFS

INSTRUCTIONAL TELEVISION FIXED SERVICE (2500 megahertz)

WHAT IT IS...HOW TO PLAN

FOREWORD

SINCE THE inception, in 1963, of the Instructional Television Fixed Service, this important complement to educational television broadcasting has shown evidence of phenomenal growth and invaluable contribution to the development of quality education in the United States. So great was the demand for information concerning the service and the need for coordination in making efficient use of available frequencies that in October 1965 the Federal Communications Commission established a national Committee for the Full Development of the Instructional Television Fixed Service.

This booklet was prepared under the auspices of the Committee. Its purpose is to familiarize those who are interested in the improvement of teaching techniques with the vast potential that the 2500 megacycle spectrum offers.

The Federal Communications Commission appreciates the dedication of the people who have made this booklet possible.

ROSEL H. HYDE, Chairman
Federal Communications Commission

ROBERT E. LEE, Commissioner
Federal Communications Commission;
Chairman, Committee for the Full
Development of the Instructional
Television Fixed Service

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ITFS

WHAT IT IS... HOW TO PLAN

Instructional Television Fixed Service

Published by The Division of Educational Technology, National Education Association, for the FCC Committee for the Full Development of the Instructional Television Fixed Service

in cooperation with

- The Consumer Products Division, Electronic Industries Association
- The National Association of Educational Broadcasters
- The New York State Education Department, Division of Educational Communications

Editor Bernarr Cooper—with the cooperation of the New York City metropolitan subcommittee of the Committee for the Full Development of the ITFS

Consulting Editors Robert L. Hilliard
Harold E. Wigren

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ACKNOWLEDGMENTS

A PUBLICATION involves many persons whose contributions are frequently overlooked. Hopefully, such is not the case with *ITFS: What It Is . . . How To Plan.* A debt of gratitude is due many people for their assistance in obtaining the needed material for this publication.

I am grateful to the planning committee, which included both public and private educators and members of the electronics industry. The goodwill, hard work, and dedication of all of the writing and planning members was always apparent. I acknowledge with deep appreciation the contributions of Dalton Levy, the Rt. Reverend Monsignor Joseph T. O'Keefe, Sven O. Swanson, Louis H. Follett, Jr., Jess L. Nickels, and Adron M. Miller. For industry's assistance in the writing and planning, I am especially indebted to the Radio Corporation of America. I appreciate, too, the comments of FCC engineers McIvor Parker and Robert A. Weston.

Special thanks go to Betty Smith and Norman W. Hosler, Jr., for their contributions and for their patience and unfailing good humor.

BERNARR COOPER, Editor
Chairman, Northeast Region
Committee for the Full Development of the
Instructional Television Fixed Service

First printing, 1967

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PREFACE

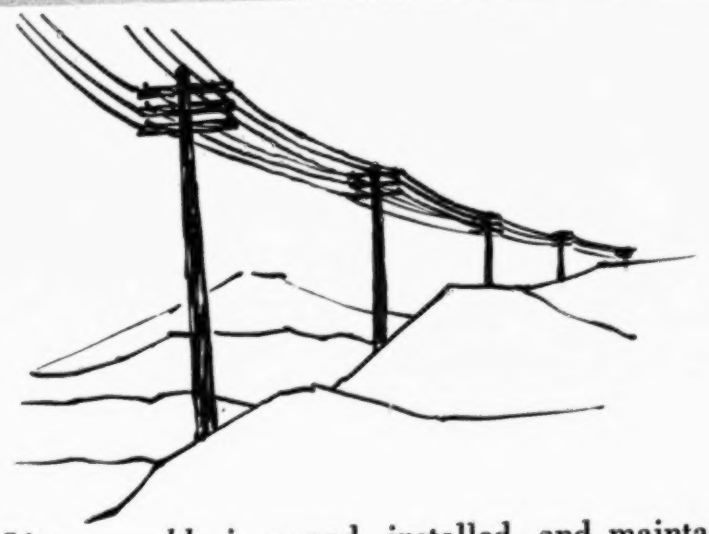
THE PURPOSE of this booklet is to present basic information on the Instructional Television Fixed Service (ITFS or, as it is frequently referred to, the 2500 megacycle or megahertz system). Designed primarily for administrators and teachers, the booklet offers guidance as to how this service might be used with maximum effectiveness in the school program.

The booklet suggests steps in planning for the introduction and use of ITFS, considers the preparation of faculty and student groups for its use, indicates the cost and time factors involved in the installation of the service, and discusses staff and equipment needs. The booklet does not deal either with technical detail or with the curriculum implications of the system once it is in operation.

PART I. BASIC INFORMATION

METHODS OF TRANSMISSION

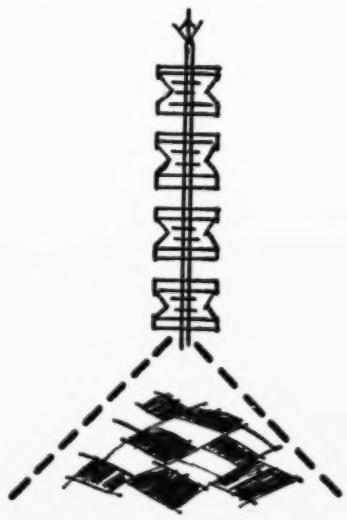
There are a number of ways of transmitting TV signals to the classroom. The Instructional Television Fixed Service, as described in this booklet, is but one of several possible methods. A brief summary of the others at this point may be helpful to the educational administrator considering the use of television.



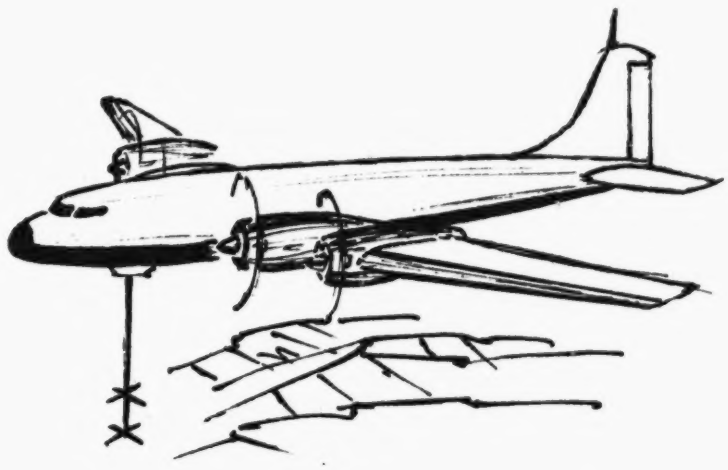
- *Line or cable* is owned, installed, and maintained by the local telephone company and can deliver several

separate TV channels. The monthly rental charge for this service is based upon the mileage between the connected buildings, plus a reception charge for each receiving location.

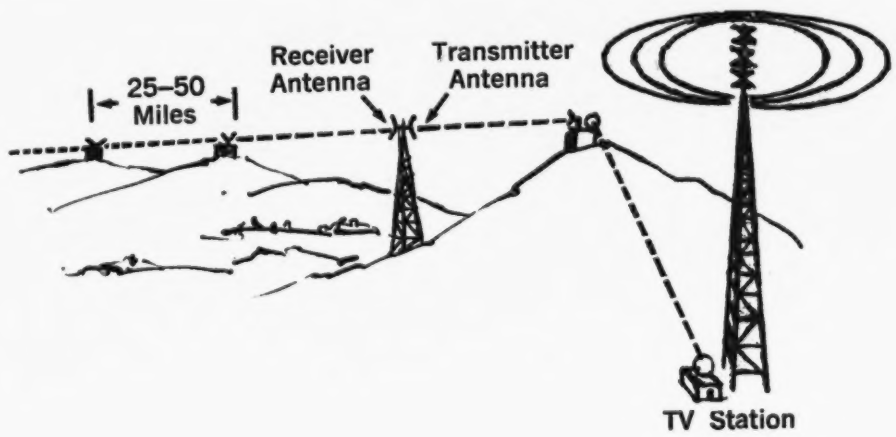
- *Community antenna television systems* (CATV) may provide a convenient means for transmitting instructional TV programs to schools in those areas that already have such systems. These systems are generally privately owned, but it may be possible to arrange with the operator to carry one or more instructional TV channels on his cable system. ETV programing is frequently carried on CATV systems at the request of the ETV station.



- *Broadcast transmission* of instructional TV is being provided by educational television stations, both VHF and UHF. These stations basically use the the same type of transmitting and studio equipment as do commercial stations. There are relatively few ETV channels assigned by the FCC in any given area. Each station, of course, provides only a single program channel. The service is usually general enough to include all school districts within the specified service area. From time to time, commercial stations have carried instructional programs as a public service.



- *Airborne* television uses an aircraft flying from 25,000 to 30,000 feet as the transmitting site. Such an experimental system, known as the Midwest Program on Airborne Television Instruction (MPATI), was inaugurated in 1961, broadcasting to schools within a six-state area from a point in east central Indiana. MPATI has received authorization from the FCC to construct six channels in the 2500 MHz band.



- *Point-to-point* service operating in the microwave portion of the spectrum is primarily used for long-distance relays between cities or from a centrally located studio

to a remote transmitter. This microwave system is sometimes used along with a 2500 MHz system to send signals to other 2500 MHz transmitters located some distance away. ITFS also operates in the microwave portion of the spectrum.

- *Coaxial cable*—a private, closed-circuit cable line owned, installed, and maintained by the user—can simultaneously distribute as many as 12 different TV or audio programs. If the cable route is entirely on owner property (such as a school building or a college campus), there is no legal problem in putting in the system. However, as is often the case, permission to use space on the poles along the route is required from the owners of the poles and/or from the local government and entails a pole rental fee.

ITFS: WHAT IT IS

On July 25, 1963, the Federal Communications Commission opened 31 channels in the 2500-2690 megahertz [1] frequency range for use by educational institutions and organizations.[2] The channels in this frequency range bear the official designation of "Instructional Television Fixed Service" (ITFS). The *FCC Rules and Regulations* (Section 74.901) defines the service as follows:

> A fixed station operated by an educational organization and used primarily for the transmission of visual and aural instructional, cultural, and other types of educational material to one or more fixed receiving locations.

Section 74.931 states the purpose and permissible service of ITFS as follows:

> (a) Instructional television fixed stations are intended primarily to provide a means for the transmission of instructional and cultural material in visual form with an

[1] *Hertz* is a unit of frequency equivalent to one cycle per second. The terms *megacycles* (Mc/s) and *megahertz* (MHz) are synonymous and may be used interchangeably.

[2] FCC rules concerning ITFS are contained in Volume 3, Part 74, Subpart I, "Instructional Television Fixed Stations," obtainable for $4.50 from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. (Many libraries and all broadcasting stations have copies of the *FCC Rules and Regulations.*)

associated aural channel to specified receiving locations for the primary purpose of providing a formal education and cultural development to students enrolled in accredited public and private schools, colleges, and universities.

(b) Such stations may also be used for the additional purpose of transmitting visual and aural material to selected receiving locations for in-service training and instruction in special skills and safety programs, extension of professional training, informing persons and groups engaged in professional and technical activities of current developments in their particular fields, and other similar endeavors.

(c) During periods when the circuits provided by these stations are not being used for the transmission of instructional and cultural material, they may be used for the transmission of material directly related to the administrative activities of the licensee, such as the holding of conferences with personnel, distribution of reports and assignments, exchange of data and statistics, and other similar uses. Stations will not be licensed in this service solely for the transmission of administrative traffic.

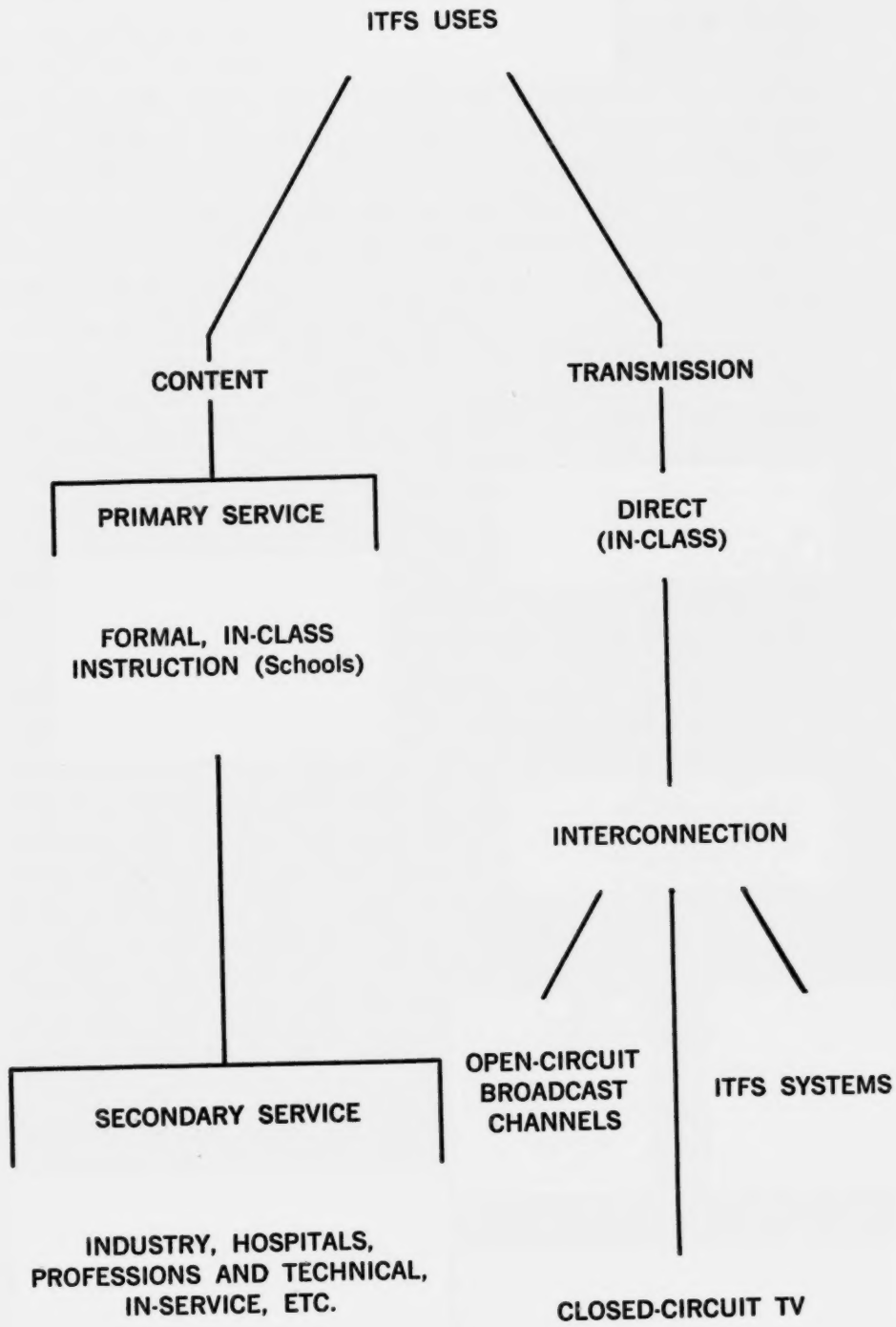
(d) Stations may be licensed in this service for operation as relay stations to interconnect instructional television fixed station systems in adjacent areas, to deliver instructional and cultural material to, and obtain such material from, commercial and noncommercial educational television broadcast stations for use on the instructional television fixed system, and to deliver instructional and cultural material to, and obtain such material from, nearby terminals or connection points of closed-circuit educational television systems employing wired distribution systems or radio facilities authorized under other parts of this chapter.

(e) Material transmitted by these stations may be intended for simultaneous reception and display or may be recorded for use at a later time.

The uses of ITFS are shown in **Figure I.** Eligibility and licensing requirements (Section 74.932) are as follows:

(a) A license for an instructional television fixed station will be issued only to an institutional or governmental organization engaged in the formal education of enrolled

Figure I.
ITFS USES



students or to a nonprofit organization formed for the purpose of providing instructional television material to such institutional or governmental organizations, and which is otherwise qualified under the statutory provisions of the Communications Act of 1934, as amended. A nonprofit organization which would be eligible for a license for a noncommercial educational television broadcast station is considered to be eligible for a license for an instructional television fixed station.

(1) In determining the eligibility of publicly supported educational organizations, the accreditation of the appropriate state department of education will be taken into consideration.

(2) In determining the eligibility of privately controlled educational organizations, the accreditation of the appropriate state department of education or the recognized regional and national accrediting organizations will be taken into consideration.

(b) No numerical limit is placed on the number of stations which may be licensed to a single licensee. However, individual licensees will be governed by the limitation of Section 74.902 as to the number of channels which may be used. A single license may be issued for more than one transmitter if they are to be located at a common site and operated by the same licensee. Applicants are expected to accomplish the proposed operation by the use of the smallest number of channels required to provide the needed service.

(c) An application for a new instructional television fixed station or for changes in the facilities of an existing station shall specify the location of the transmitter and all proposed receiving installations which will be under the control of the applicant or will be equipped for reception by the applicant. If reception is also intended at unspecified locations, i.e., if power is deliberately radiated to locations or areas so that voluntary reception will be possible, the applications shall include a complete statement as to the purpose of such additional reception.

An applicant is limited to no more than four channels to serve a single area. This does not preclude the assignment of additional channels to serve a different area. However, such

additional channels shall be available for use by another licensee in the first area. An applicant may apply for one channel and request reservation of the others in the same group, as indicated under the FCC rules, Section 74.902(c):

> A licensee is limited to the assignment of no more than four channels for use in a single area of operation, all of which must be selected from the same Group listed in paragraph (a) of this section. An area of operation is defined as the area in which the use of channels by one licensee precludes their use by other licensees. Applicants shall not apply for more channels than they intend to construct within a reasonable time, simply for the purpose of reserving additional channels. Applicants applying for more than one channel shall submit to the Commission a plan indicating when they intend to begin and complete construction of each channel applied for, and the Commission will determine whether or not a grant of the channels requested would serve the public interest. Applicants initially proposing the operation of less than four transmitters may request that the remaining channels in the same Group be reserved for future expansion of the system. The Commission will undertake to avoid assigning the remaining channels in the Group to other applicants as long as such action is feasible in the judgment of the Commission. The provision for a maximum of four channels to a single licensee shall not be construed as a guarantee that four channels will be assigned.

Frequency assignments are shown in **Table 1.**

The FCC rules further provide that ITFS signals be limited in power so they can be received only at locations which are a relatively short distance from the transmitting site. (This distance varies from 5 to 20 miles, depending upon the terrain.) It is a point-to-point service from a transmitter to one or more designated receiving locations. Although the signal is transmitted in much the same way as is the broadcast television signal, it requires a special receiving antenna and down-converter unit and can be received only in those buildings so equipped. ITFS is a private distribution system in which preselected receiving points are connected by radio signals instead of by cables. Transmissions are not intended for direct home recep-

Table 1.

CHANNEL GROUPS AVAILABLE IN ITFS

Group A		Group B		Group C		Group D	
Channel No.	Band limits MHz	Channel No.	Band limits MHz	Channel No.	Band limits MHz	Channel No.	Band limits MHz
A-1	2500-2506	B-1	2506-2512	C-1	2548-2554	D-1	2554-2560
A-2	2512-2518	B-2	2518-2524	C-2	2560-2566	D-2	2566-2572
A-3	2524-2530	B-3	2530-2536	C-3	2572-2578	D-3	2578-2584
A-4	2536-2542	B-4	2542-2548	C-4	2584-2590	D-4	2590-2596

Group E		Group F		Group G		Group H	
Channel No.	Band limits MHz	Channel No.	Band limits MHz	Channel No.	Band limits MHz	Channel No.	Band limits MHz
E-1	2596-2602	F-1	2602-2608	G-1	2644-2650	H-1	2650-2656
E-2	2608-2614	F-2	2614-2620	G-2	2656-2662	H-2	2662-2668
E-3	2620-2626	F-3	2626-2632	G-3	2668-2674	H-3	2674-2680
E-4	2632-2638	F-4	2638-2644	G-4	2680-2686		

tion by the general public. Therefore, ITFS is neither a broadcast (open-circuit) system nor a closed-circuit system in the sense of wired (cable) installations.

HOW IT BEGAN

Every educational innovation has at least three major elements: a recognized and identifiable educational need, a means for satisfying this need, and an educational institution willing and able to engage in the experiment.

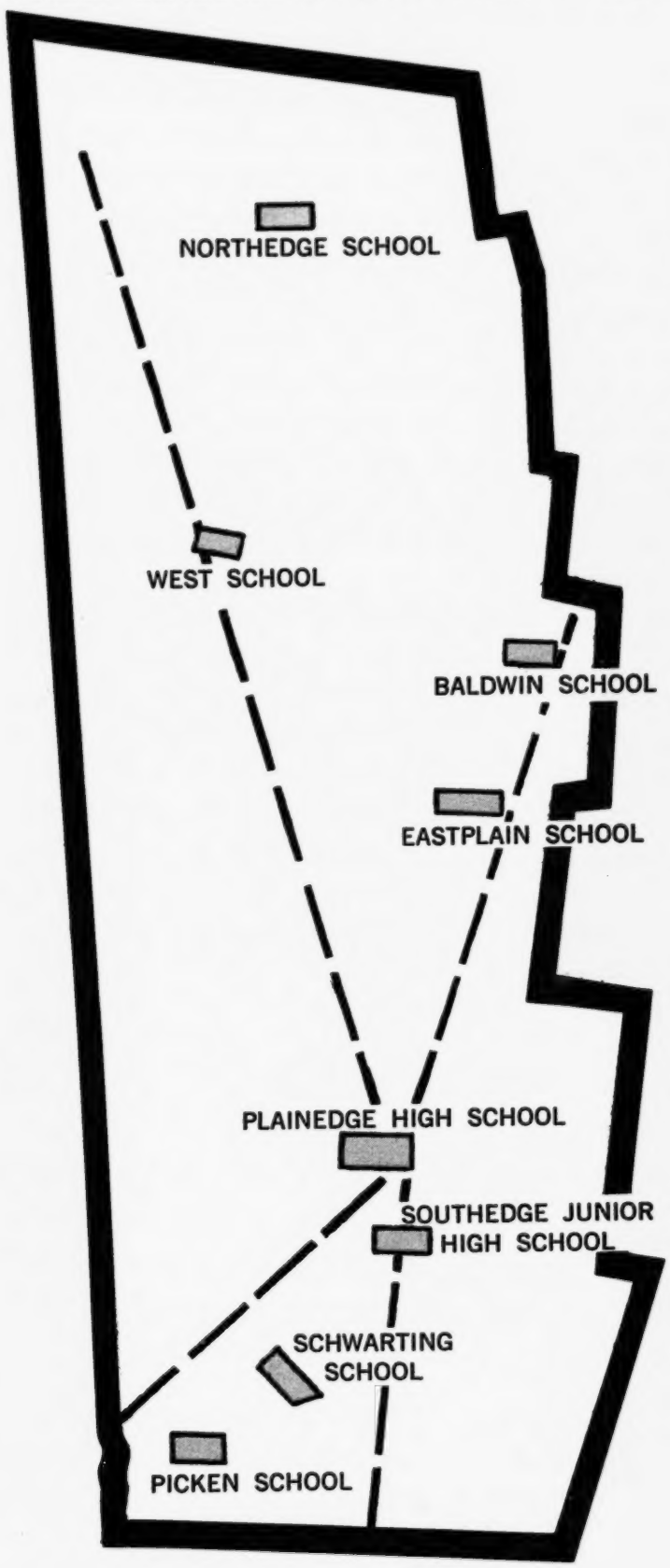
One of the needs which educators have identified is that of providing a more economical and efficient means of distributing high quality learning materials to classrooms. However, accessibility requires a means of transmission that provides for the ready availability of the material. The following questions were raised: Could television, proven effective as a learning resource, also be used as a multiple-distribution means? Could instructional materials be transmitted within a school system without using scarce or unavailable broadcast space? Could microwave facilities be used to accomplish this task? Could more than one subject and more than one grade level be served simultaneously?

The Union Free School District 18 on Long Island, New York (the Plainedge Public Schools), recognized for its use of new audiovisual materials and experiments with new teaching techniques, volunteered to test the feasibility of these concepts. (See **Figure II.**)

The Federal Communications Commission gave its permission in 1961 for Plainedge to experiment in the relatively uncrowded frequency range of 2000 megacycles. When Commissioner Robert E. Lee viewed the demonstration on June 14, 1962, he commented on its simplicity, capability, and utility. He stated, "It may well be that Plainedge, New York, will be to education what Kitty Hawk was to the aircraft industry."

Later, the FCC determined that the 2500 to 2690 megacycle range was more suitable for such instructional applications and would accommodate a multiple channel potential. The new Instructional Television Fixed Service was established on

Figure II.


THE PLAINEDGE
PUBLIC SCHOOLS—AN EXPERIMENT IN ITFS
NORTHEDGE SCHOOL
WEST SCHOOL
BALDWIN SCHOOL
EASTPLAIN SCHOOL
PLAINEDGE HIGH SCHOOL
SOUTHEDGE JUNIOR HIGH SCHOOL
SCHWARTING SCHOOL
PICKEN SCHOOL

July 25, 1963. Within a matter of months construction permit requests were submitted for every available channel group in Nassau County, Long Island. The first systems actually to go on the air were the Mineola (Long Island) and Parma (Ohio) school districts, both on September 28, 1964.

By July 1967 the FCC had received more than 120 construction permit requests for over 330 ITFS channels.

STRENGTHS AND LIMITATIONS

ITFS has several unique characteristics:

- It is especially adaptable for local school use.
- It is flexible because it provides a multichannel system that enables the administrator to cope more effectively with traditional scheduling problems which, up to now, have plagued instructional TV.
- Programs may be repeated whenever required, and up to four different programs may be transmitted simultaneously.
- It is relatively economical to use.
- When combined with other methods of TV transmission, it can provide electronic flexibility and capability heretofore unavailable.

The educational institution or system that plans to use ITFS must be aware of limitations as well as potentials of the service. One inherent danger is that the educational administrator may believe that an ITFS system will provide him with the totality of his educational TV needs.

ITFS must operate within certain limitations and regulations:

- The inability of ITFS, under present technology and rules, to reach the public outside of the classroom, thereby precluding nonclassroom, preschool, and other special uses
- The need to engage in local and regional cooperative planning for optimum use of available channels and for effective development of program resources
- Limitations on power and coverage area
- The need to obtain a license from the FCC

- The need for multiple studios and/or multiple dissemination sources such as video tape recorders and film chains to serve a multichannel service.

An ITFS system operates best in a communications system approach, as part of the coordinated use of all available educational communications media. Some administrators may believe that an ITFS system can easily produce and disseminate all the instructional programing needed by a school. To do so would require not only expensive but largely unavailable personnel, as well as costly equipment.

The administrator should keep in mind that an ITFS installation must have equipment (cameras, video tape recorders) of high capability and compatibility, or the productions will suffer and the system will be isolated from other systems and sources of material. Video tape recorder compatibility is particularly essential to avoid the latter possibility. The administrator must be extremely wary of beginning studio production until the ITFS system is ready with quality personnel and equipment.

PART II. PLANNING AND PREPARATION

HOW TO GET STARTED

An ITFS system should play a major role in increasing the effectiveness of student learning and in providing learning resources not otherwise available. This must be recognized by the instructional staff before an initial commitment is made and administrative support and encouragement sought.

The Role of the Administration and Faculty

First, the administration and faculty should obtain information and insights as to the nature of the TV medium and its implications for learning and teaching effectiveness. Then they should investigate how the use of television can affect the instructional program of their particular school district or institution. Finally, they should define the specific problem by asking such questions as: What is the role of television in relation to other means of learning and teaching? How will instructional television be used? For what services? For what groups of students? Under what conditions? For what particular instructional objectives? Such preplanning may avoid the embarrassing question: "Now that we have a TV installation, what do we do with it?" The answers to these questions are part of the broad concepts of television use and frequently must

be articulated to a board of education, a board of trustees, a state executive or legislative body, and the community.

The Instructional TV Consultant

Once the basic decision is made to use ITFS, an instructional TV consultant should be employed. The time, effort, and money saved by his knowledge and experience will more than offset the cost of such a position.

The possibility of obtaining consulting assistance at the state level should be investigated. Many states, and sometimes state universities, have personnel who are specialists in the use of instructional TV. Sometimes these persons are available to school systems within the state for initial or long-range help in orientation, investigation, and planning. National organizations that make consulting services available are listed under "Program Sources."

The fundamental role of the ITV consultant is to determine the instructional and administrative needs that can be met through television, to work with the faculty and administration to prepare them for effective use of this medium, to present demonstrations, and to disseminate information to various staff and departmental groups. The ITV consultant works with the overall curriculum committee, as well as with television and program planning committees in a team effort to determine in what areas the new system can be used most effectively and to implement the aims and objectives underlying the decision to use television as a medium for instruction. The ITV specialist may, of course, also be the overall media specialist for the entire system.

The Engineering Consultant

An engineering consultant should be employed to interpret what sort of electronic system will best meet the required educational goals, and he would generally perform the following functions under the direction of the ITV or media specialist:

- Arrange for the preliminary topographic survey and the final actual survey.

- Design a system to accomplish the educational purposes (within the available budget).
- Write equipment specifications and obtain firm quotations from manufacturers.
- Assist in acquiring necessary site(s) for the transmitting antenna.
- Prepare the necessary FCC and Federal Aviation Agency application forms, in cooperation with a legal consultant. (The FAA may require information on tower heights, particularly that of the transmitter antenna.)
- Inspect the installation as it progresses.
- Test and certify the completed system for compliance with specifications and for proper performance.

The ITFS Time Schedule

Time is an important element. Even after the basic decision to proceed has been made, many weeks or months may elapse between the initial topographic survey and the day the system actually begins its instructional programing to schools. **Table 2** gives a rough indication of the time required to get on the air. The times shown are *minimum* for moderately sized systems. Even more time should be allowed—as much as one year or more—for a large or complex system. Generally speaking, if a moderate-sized system must be ready by the beginning of a school year in September, the previous January would not be too early to begin work.

STAFFING AND OPERATING

No matter how well-planned, designed, and installed an ITFS system may be, it cannot run itself. A well-qualified and adequate staff is a necessity. **Figure III** suggests two possible methods of organization within a school system and indicates possible relationships between the chief administrator for instruction and the TV staff, the curriculum supervisors and the TV coordinator, and within the TV staff itself.

Table 2.
SAMPLE ITFS SCHEDULE (IN WEEKS)

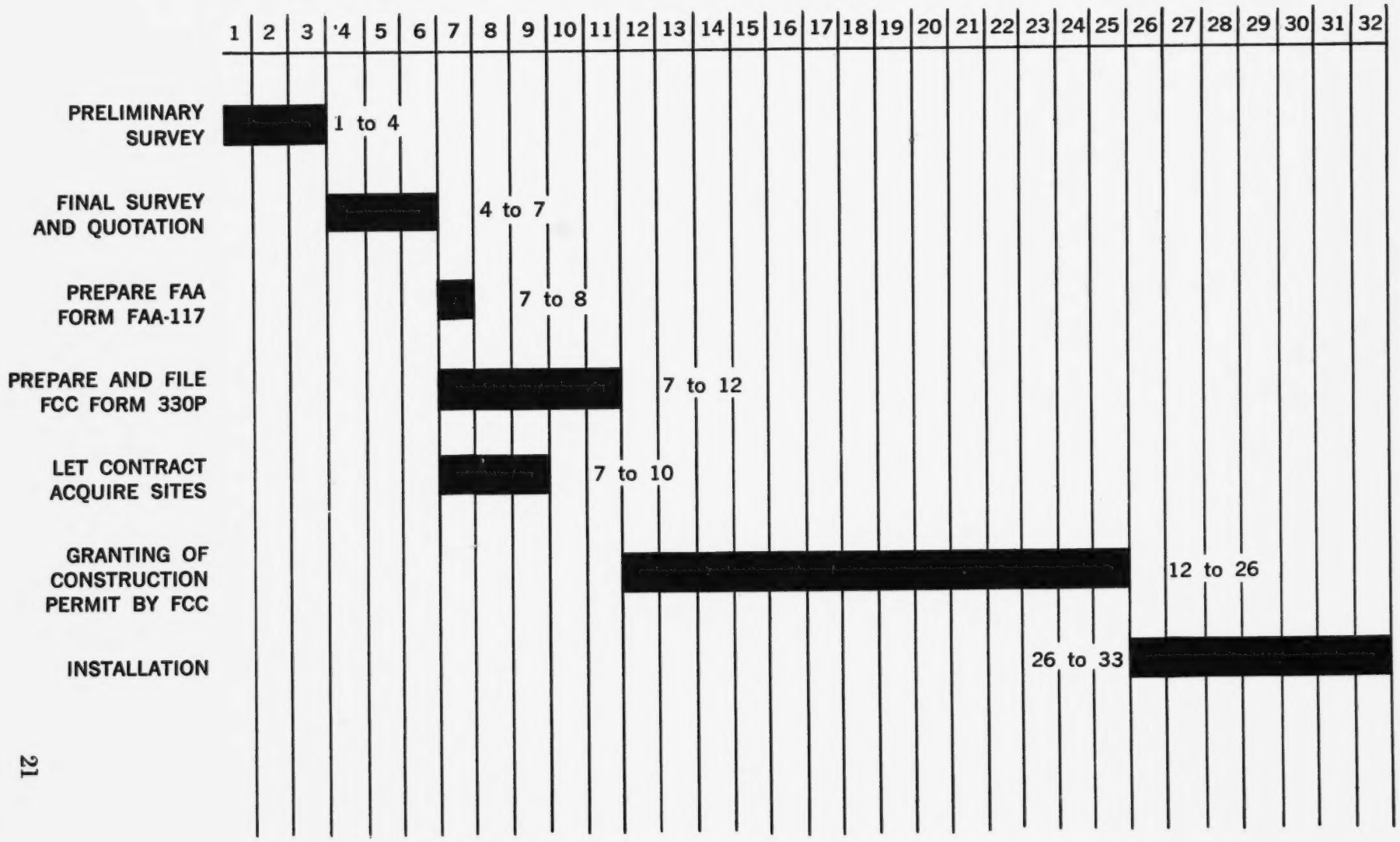

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
PRELIMINARY SURVEY
1 to 4
FINAL SURVEY AND QUOTATION
4 to 7
PREPARE FAA FORM FAA-117
7 to 8
PREPARE AND FILE FCC FORM 330P
7 to 12
LET CONTRACT ACQUIRE SITES
7 to 10
GRANTING OF CONSTRUCTION PERMIT BY FCC
12 to 26
INSTALLATION
26 to 33

Figure III.
SUGGESTED ADMINISTRATIVE PATTERN FOR ITFS[a]

CHART A

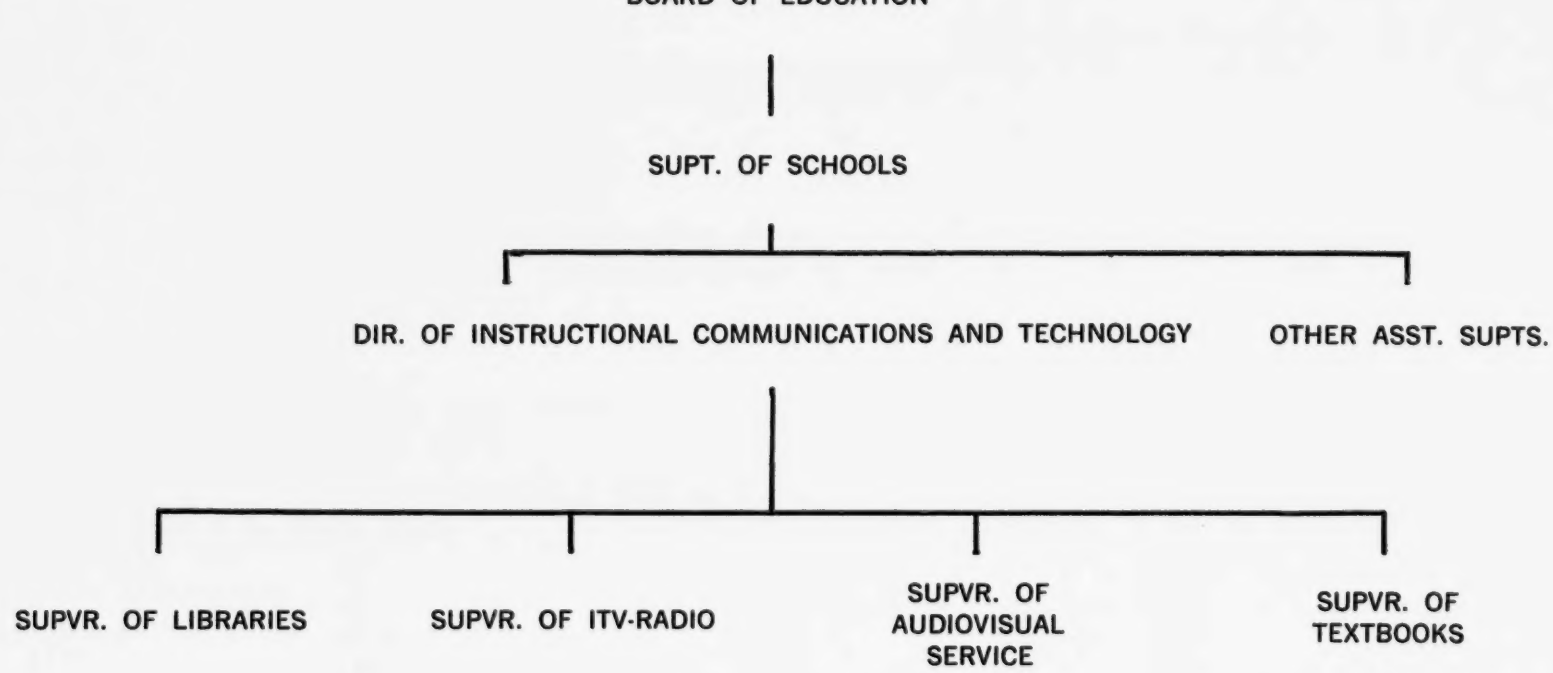
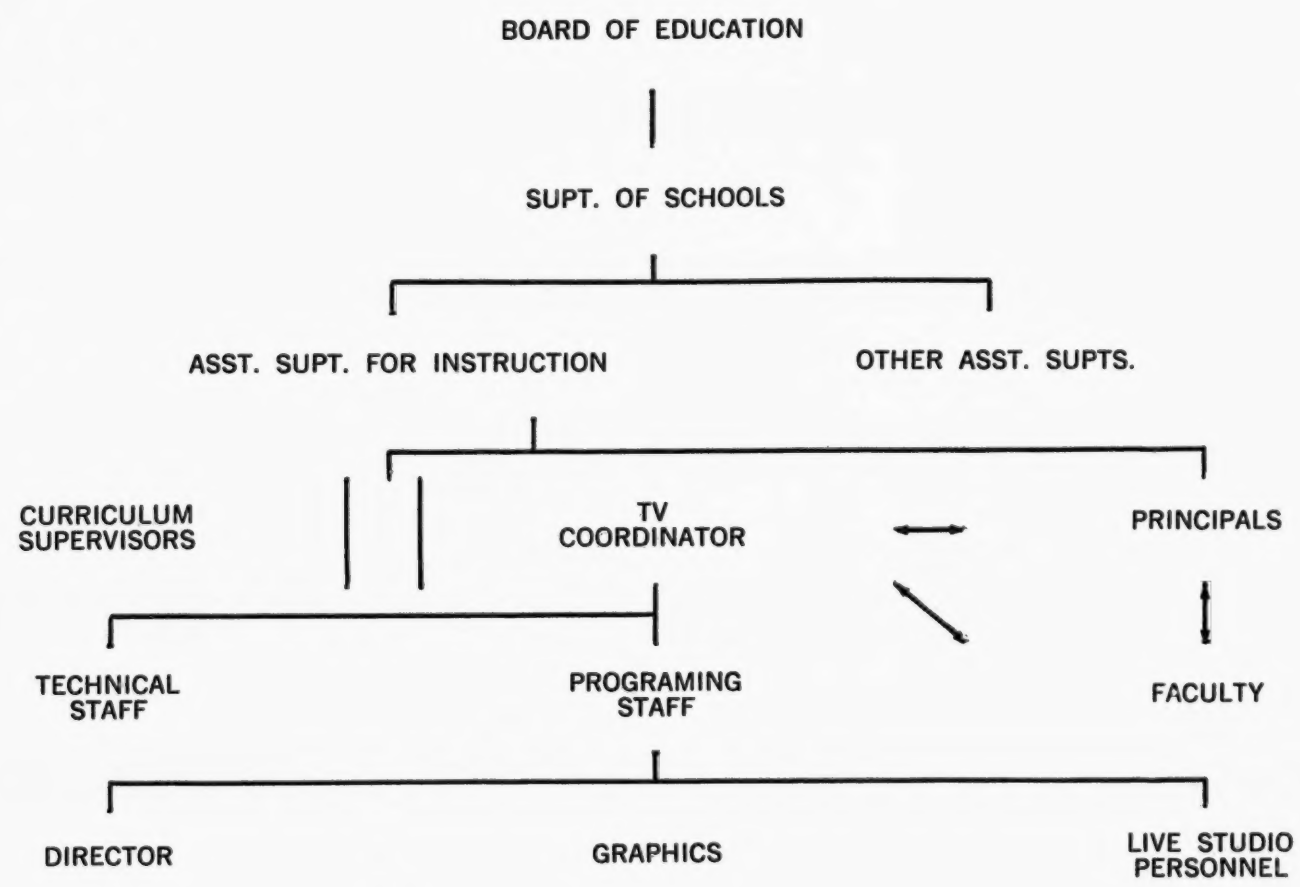


CHART B



[a] Chart A is recommended by the Department of Audiovisual Instruction of the National Education Association; Chart B, as compiled by the Northeast Regional subcommittee for the Full Development of the Instructional Television Fixed Service, is typical of a pattern frequently used.

The Television Coordinator

Whatever the organizational arrangement, the person chosen to assume leadership responsibility in television should begin his work as soon as possible after the decision has been made to use television for instructional purposes. The instructional TV consultant may very well remain on the staff as the TV coordinator. His role would be to establish a close working relationship with principals and curriculum personnel, to be responsible for TV staff development and supervision, to work with outside consultants, and to participate in decision making during the planning and initial stages of engineering, construction, and staff and faculty preparation. His central responsibility is to encourage, plan, and conduct in-service education for classroom use of television.

The Programing Staff

The programing staff is responsible for production and/or procurement of instructional materials for televised presentation as determined by the curriculum supervisors, the TV coordinator, and the faculty. The resources and production services of the audiovisual or communications center should be coordinated with the television program. Where a well-organized center is already in existence and is serving the instructional needs of the school or institution, television activities will become a part of the overall function and an operational arm of the center.

The amount of locally produced program materials will vary. Although one of the special advantages of the ITFS system is to permit the development of materials specifically oriented to the needs of the individual school or system, all such production should be of the highest quality possible; some systems may need time to reach a quality production stage before they can produce in any given quantity. Generally, most of the programing will come from ITV library centers and/or will be produced for the ITFS systems by the local ETV station.

While the TV coordinator prepares information on content and instructional goals and makes arrangements for teaching

personnel, the programing staff supplies the actual TV expertise in the preparation and presentation of live programs and video tapes.

The Studio Director

The studio director or the producer-director is responsible for all elements of the production, such as making the final judgment on the balance of lighting, selecting what is seen on the screen, and directing the camera personnel. He is assisted by persons trained in the selection of films and the preparation of graphics and by studio personnel who set up and operate lighting, cameras, sound, and other production elements.

The Technical Staff

An ITFS technical staff is concerned with three basic areas: the studio, the transmitter, and the receiving schools.

- The *studio engineer* is responsible for the operation and maintenance of all studio TV equipment. He works closely with the production personnel in the actual televising of lessons, whether live, tape, or film. He is in charge of the technical supervision and training of the cameramen, audio operators, and other members of the operating crew.

In some larger systems, the members of this operating crew may be paid staff specialists. In most systems, high school or college students or paraprofessionals can be trained for these duties.

- The *transmitter operator* should be a skilled technician, whose chief responsibilities are confined to the operation, maintenance, and periodic adjustment of the transmitters. Many systems combine this job with that of the studio engineer. FCC rules state that the transmitter operator may have other duties, so long as they do not interfere with his chief responsibility—the proper operation of the transmitter.

The station must operate in accordance with its FCC license, which must be kept posted at the transmitter. Actual operation of the transmitter apparatus may be conducted only by a licensed operator. Licenses may be obtained by passing an

FCC examination, as described in Volume I, Part 13, of the FCC *Rules and Regulations*. The operator must be technically competent to perform operational and maintenance checks on and adjustments to the TV transmitter.

• A *technician* must operate and maintain the relay transmitters, receiving down-converters, distribution systems, and classroom receivers. In some systems he may also maintain and adjust the main transmitters.

Most ITFS systems, unless extremely limited in size, will require a centralized maintenance facility. At such a facility an inventory of spare parts can be maintained, such as spare head-wheel panels for the tape machines and extra parts, tubes, and transistors for the TV equipment. Normally, the best location for the repair facility is adjacent to the studio. It should be accessible only to authorized maintenance personnel, such as studio maintenance crews or transmitter technicians. Failure to include plans for adequate maintenance facilities in initial system planning can be a costly error. Adequate annual budgeting for the efficient operation of this maintenance facility is important.

PROGRAM SOURCES

After program planning has been completed by the school administrators, curriculum coordinators, and faculty—according to the curricular needs of their school or system—program sources must be evaluated.

The effective use of TV requires a wide variety of materials and many program sources—national, regional, state, and local. Cooperative programing can be a means of combining resources nationwide and, indeed, is essential at every level. At the same time, the unique characteristics of a geographical area as well as those of an individual institution or a local system can be shared throughout the nation.

It must be remembered, however, that live studio production is more costly than programing limited to films and video tape. In addition to equipment, live production must include staff for production, graphics, and writing—plus the necessary

office facilities. As indicated earlier, the additional expense may be justified if it results in high-quality materials that are tailor-made to local needs.

Film and Video Tape Programing

No matter what the degree of live production, ITFS systems have made excellent use of existing instructional materials on both film and video tape. Some sources for such programing follow:

- Center for Instructional Television
  Eastern Educational Network
  575 Technology Square
  Cambridge, Massachusetts 02139
- Great Plains Instructional TV Library
  University of Nebraska
  Lincoln, Nebraska 68508
- Midwest Program on Airborne Television Instruction, Inc.
  Memorial Center, Purdue University
  Lafayette, Indiana 47907
- National Center for School and College Television
  Box A
  Bloomington, Indiana 47401

Instructional programs also may be obtained from other sources, including some state education departments and some city school systems. Arrangements often may be made for the duplication of such programs onto the video tape of the user institution. Costs will vary, depending upon the length of time the material will be borrowed, the number of times that it is used on the air (or that it passes a recording head), and the average daily attendance or number of students enrolled in a given subject or grade level. Frequently, a fixed fee is charged.

Film and off-the-air recordings of programs, in addition to video tape, also may be used. For off-the-air retransmission, written permission must be requested and received from the originating station.

Copyright Restrictions

ITFS system administrators should be aware of copyright restrictions. In spring 1967, Congress was still considering revision of the copyright law. Be sure to determine what restriction, if any, pertains to the material you wish to use and obtain clearances as necessary. At the same time, determine what exemptions the law provides for certain kinds of materials, for the ITFS transmission system, and for the instructional uses you are making of the material. Depending on the requirements of the law, staff time may be needed for obtaining clearances.

Live Programing

A school system or educational institution must determine to what degree live, original programing is both desirable and necessary to meet specific instructional needs or services and to what degree these needs may be met by recorded programs from other sources. Advice on live programing and on preparing teachers, planning guides, developing evaluation instruments, and building effective use may be obtained from several sources, including instructional communications consultants at universities and colleges and in state departments of education. The following are two major national sources for instructional television planning:

- Division of Educational Technology and/or the
  Department of Audiovisual Instruction
  National Education Association
  1201 Sixteenth Street, N.W.
  Washington, D.C. 20036
- Instructional Division
  National Association of Educational Broadcasters
  1346 Connecticut Avenue, N.W.
  Washington, D. C. 20036

An obvious source for instructional talent is within the school system itself. Many teachers who are well-versed in their particular subjects would welcome the opportunity to extend their teaching influence through the TV medium. Unfortunately, not

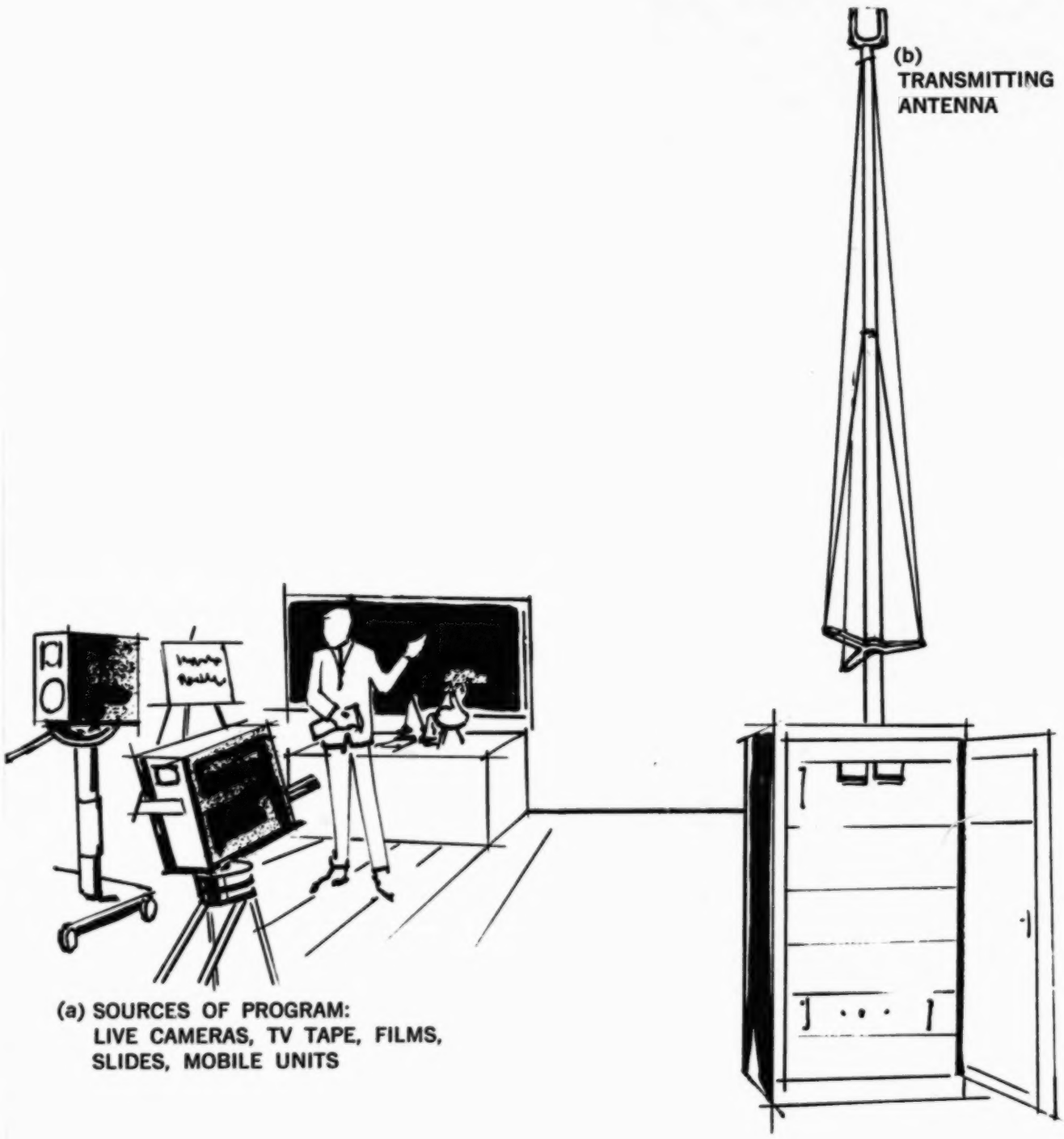
all good classroom teachers are good TV teachers. The following are some of the desirable attributes of a television teacher:

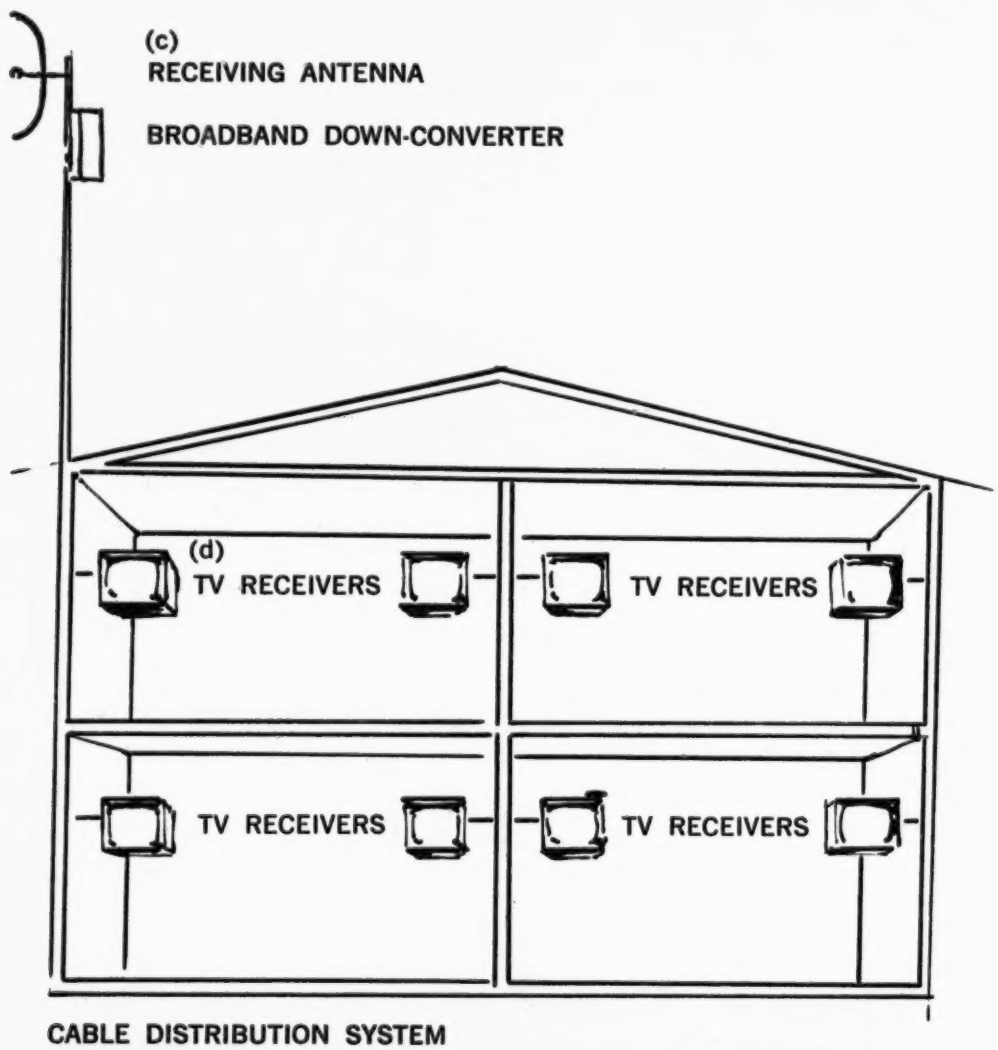
- Ability to project a warm and pleasing personality
- A creative and imaginative mind
- Ability to think and plan visually
- A dignified but relaxed manner
- Cooperativeness and the ability to work well with others
- Ability to communicate ideas and stimulate thinking
- Ability to adjust to unexpected situations
- A sense of humor
- A positive attitude toward TV
- Ability to learn potentials of TV techniques
- Ability to accept changes in approach
- Ability to plan and develop a lesson
- Ability as a classroom teacher
- Competence in subject matter.

Many fine sources for local, live production exist within the community: museums, historical sites, government offices, colleges and universities, performing centers, and business and industrial establishments. Sometimes these resources can be brought to the studio. More often, special technical mobile equipment—requiring additional capital investment—is needed for optimum exploitation of these resources.[1]

[1] For guidelines on effective use of materials, see the NEA publication *And TV, Too!*, published jointly by the Department of Audiovisual Instruction and the Department of Classroom Teachers, 1961. 64 pp. Single copy, $1.25.

Figure IV.
COMPONENTS OF AN ITFS SYSTEM





CABLE DISTRIBUTION SYSTEM
WITHIN SCHOOL

PART III. BASIC TECHNOLOGY

Figure IV shows the basic components of an ITFS system: (a) studio equipment, which feeds the signal to (b) the transmitter, which in turn broadcasts the signal to (c) the receiving antenna and down-converter at the receiving site for cable distribution to (d) the individual classroom receivers.

SIGNAL PATH

Figure V illustrates the important elements of a typical ITFS system. It traces the path of the TV lesson from its origin in the studio to its destination—the classroom.

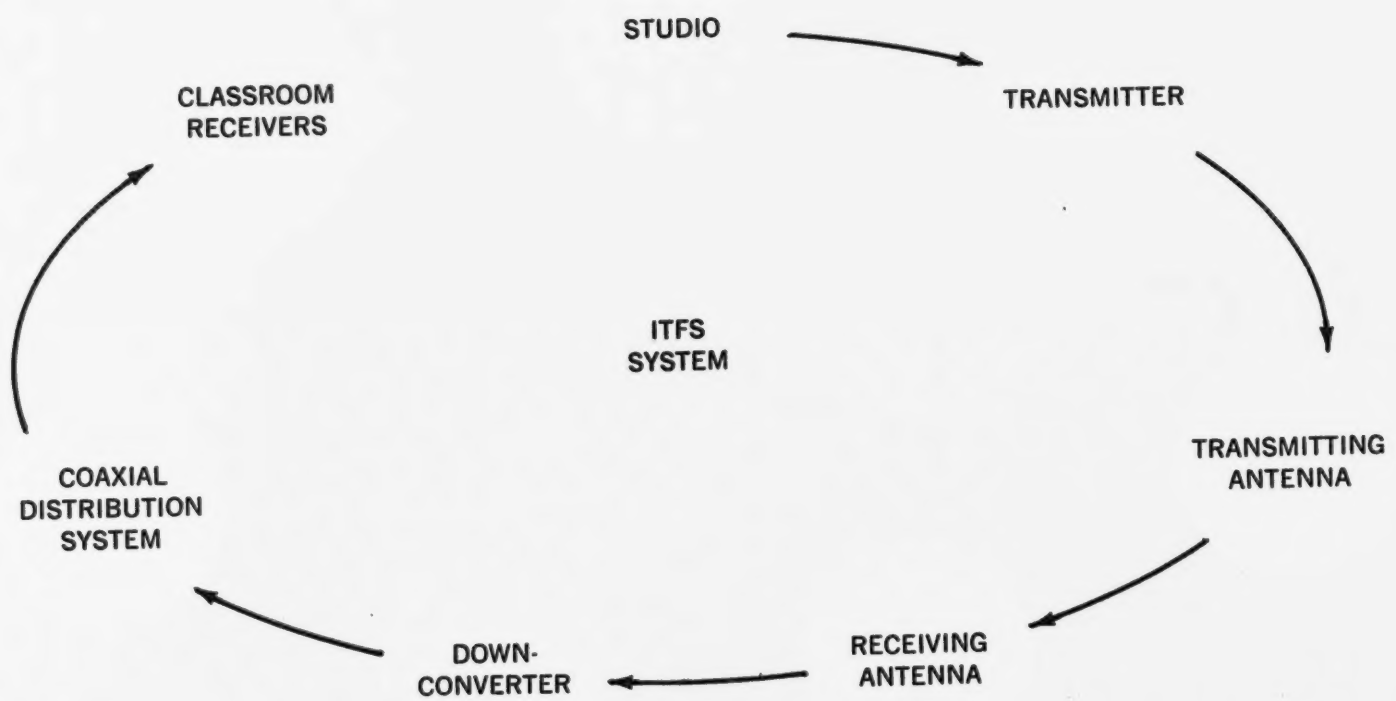
Studio Equipment

Studio equipment for ITFS use is basically the same as studio equipment for any other television use. It is therefore not discussed here, but more appropriately under Part IV, "Estimating Cost of Equipment."

The Transmitter

The purpose of the transmitter is twofold: It generates the basic 2500 megahertz signal and superimposes on this signal two vital components previously generated in the studio—the picture and the sound.

Figure V.
PATH OF THE TV LESSON



After leaving the transmitter, the ITFS signal—picture and sound—is sent through a short cable to the transmitting antenna. This antenna, along with the transmitter, may be located near the center of the geographical area to be covered. In this case, an omnidirectional antenna is used which radiates or sends out the signal *in all directions*. On the other hand, terrain, availability of land or a building for a tower site, or other factors may make it more convenient or desirable to locate the transmitter near the boundary or one edge of a school district. In this case, a directional antenna may be used to concentrate the signal *only in* selected directions to serve the desired school district, thereby avoiding a wasteful dispersion of signals over areas not intended to be served.

The Receiving Antenna

A receiving antenna is installed on the roof at each receiving location to absorb a sufficient amount of the signal (as radiated from the transmitting antenna) to enable the receiving equipment to perform its particular service in the system. The comparatively small size of the individual antenna elements makes the use of relatively elaborate receiving antennas practical.[1] Such elaborate receiving antennas not only enhance the desired signals but discriminate against unwanted signals as well.

The Down-Converter

From the receiving antenna, the signal travels to the receiving converter, usually installed next to the antenna. This unit converts 2500 MHz signals to channels receivable on a standard TV receiver. This converter, often referred to as a *down-converter*, can simultaneously receive and process all channels of a particular frequency group. Thus, although a separate transmitter is needed for each active channel, only one receiving converter is needed for each receiving location. For example, if a system has four ITFS channels, four transmitters are needed, but only one receiving antenna and converter are

[1] The size of a given antenna depends upon the frequency (or channel) of the signal it is to receive. For example, one commonly used 2500 MHz receiving antenna is a 6-foot parabolic antenna, i.e., a circular dish-shaped device 6 feet in diameter. For comparable performance on TV broadcast channel 14, this antenna would have to be 30 feet in diameter. For TV broadcast channel 2, it would have to be 300 feet!

needed at each receiving site, such as a school building. Where several buildings are grouped close together, it might be feasible to install a receiving antenna and converter on just one building and carry the signal(s) to the others via cable.

The Classroom Receiver

Cable carries the converted 2500 MHz signal, now on regular TV broadcast channels, from the converter to a standard television receiver in each classroom. If the signal, for example, reaches the school on 2506 MHz and the receiver does not have an active signal being received on channel 6, then channel 6 is the one selected for the conversion. In a four-channel ITFS system, therefore, the converter changes the four 2500 MHz signals (all on different frequencies between 2500-2690 MHz) into four signals that can be received on whatever four channels between 2 and 13 (i.e., 7, 9, 11, 13) are not in operation in the given locality, just as if they were originally broadcast on those channels.

SIGNAL STRENGTH AND DISTANCE

The useful distance or range of an ITFS system depends upon the following factors:

- Transmitter power
- Transmitting antenna height and design [2]
- Character of the terrain (between the transmitting and receiving locations)
- Height and design of the receiving antenna
- Sensitivity of the receiver.

Figure VI illustrates the relationships between the various TV channels and shows three different types of receiving antennas. The proper type is chosen depending on signal strength, distance, location, and terrain.

When there is a line-of-sight path between the transmitting and receiving antennas (illustrated in **Figure VII**) satisfactory reception for a distance of about 20 miles may be expected. The distance may be extended by the use of more elaborate receiving antennas, such as the parabola.

[2] By concentrating the power from the transmitter into desired vertical and horizontal planes, the effective radiated power will be several times the transmitter power output.

Figure VI.
CHANNELS AND ANTENNAS FOR TELEVISION

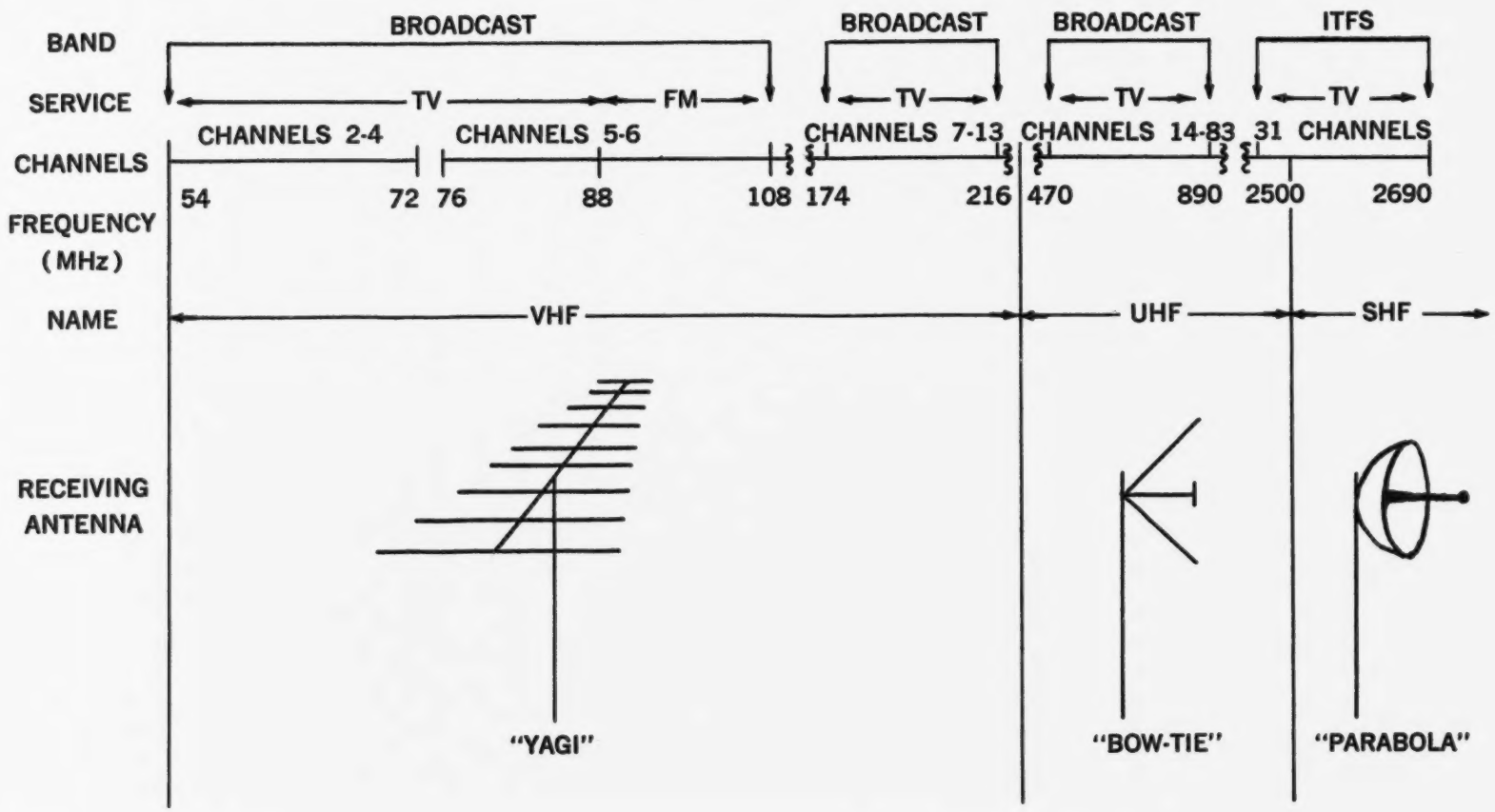


Figure VII.
LINE-OF-SIGHT ILLUSTRATION

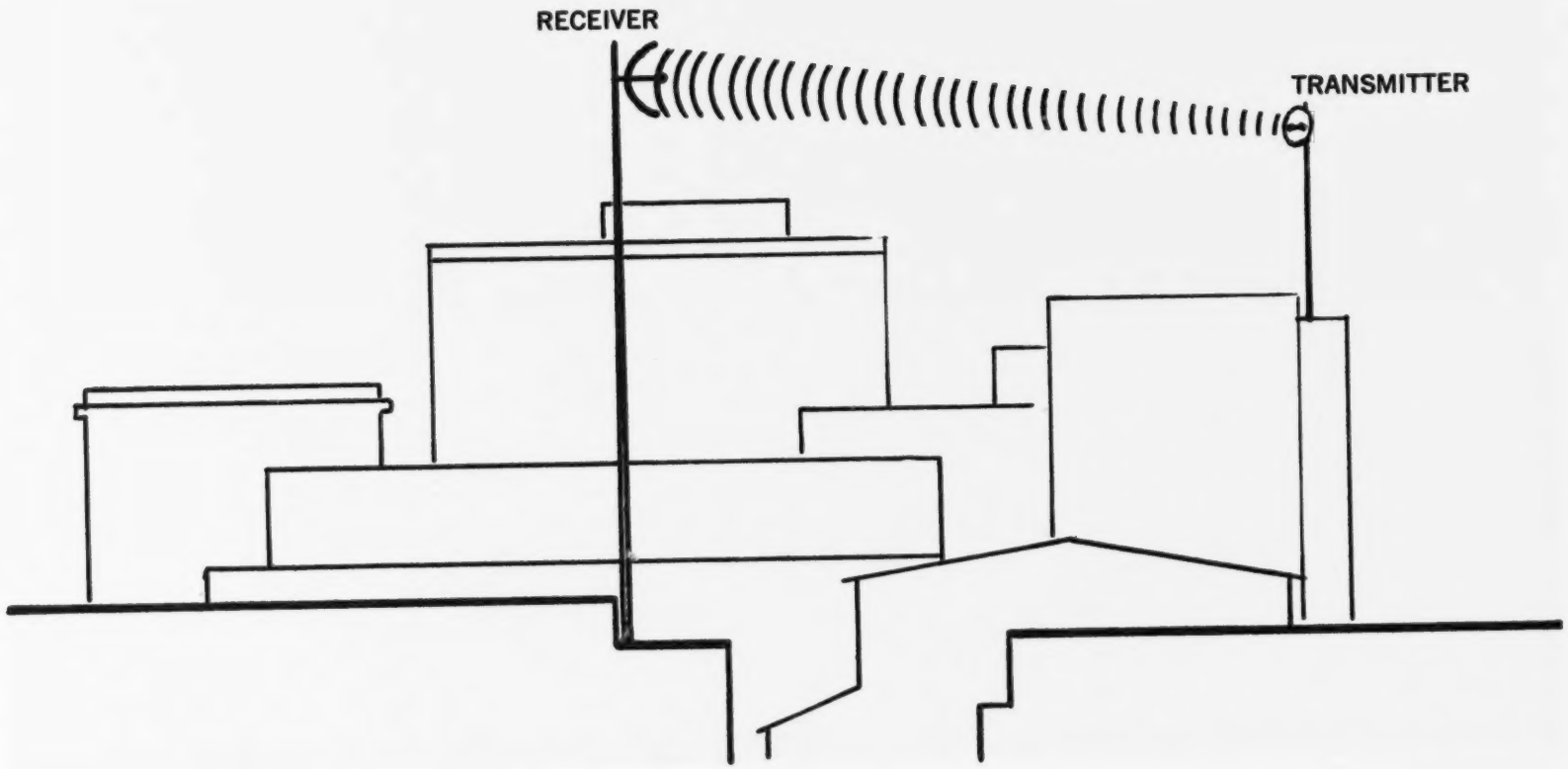
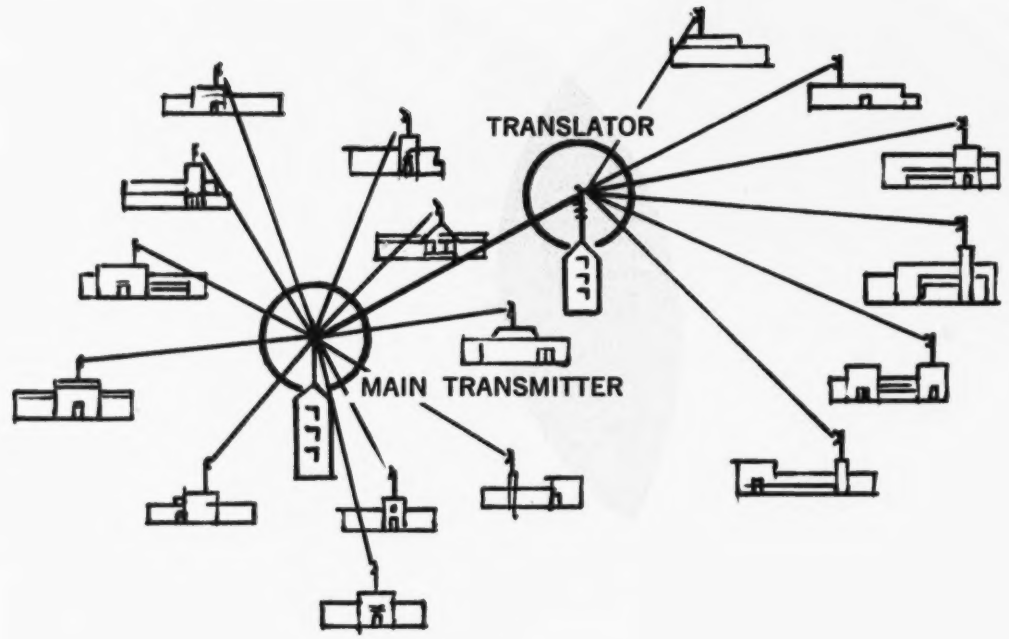


Figure VIII-5
TYPICAL TRANSLATOR APPLICATION



The translator receives the signal from the main transmitter and feeds it to another transmitter at the same location. This transmitter then rebroadcasts the signal to schools beyond the range of the main transmitter.

There are other ways to extend coverage beyond the normal range of the transmitter. Coaxial cables may be rented or leased from a local common carrier to interconnect the schools on a closed-circuit basis. Another approach is to use ITFS relay transmitters, which are comparable to broadcast translators or boosters. Still another approach is to feed an ITFS program to an ETV station to serve a wider area.

Figure VIII shows a typical application. Note that the relay transmitter actually receives the signal of the main transmitter just as one of the schools would; but, instead of feeding it to a distribution system, it feeds the signal containing the original program information to another transmitter at the same location. This latter transmitter in turn re-radiates this information on another channel or channels to schools beyond the range of the main transmitter. These relays are sometimes referred to as *repeaters.*

While it might be possible to set out certain guidelines for the selection of transmitting and receiving equipment for a particular system, the large number of system configurations, coupled with a diversified line of commercial equipment, make this a task beyond the scope of this booklet. A reputable engineering consultant can offer advice and recommendations carefully aimed at selecting a system that brings about maximum performance and coverage and equipment compatibility at the lowest possible cost. He should be retained when plans for the ITFS system are in their formative stage.

PART IV. ESTIMATING COST OF EQUIPMENT

To make reasonably accurate cost estimates for an ITFS system, four separate categories must be considered: survey costs, transmitting equipment costs, studio equipment costs, and receiving and distribution equipment costs. (Installation costs will be included in each segment.)

SURVEY COSTS

A topographic survey must be made to obtain an accurate estimate of total cost. The results of this study will establish the number of individual schools in any school complex that will receive satisfactory signals. ITFS transmission will in most cases require *absolute* line-of-sight clearance between the transmitting and receiving antennas.[1] Topographic obstructions such as trees, buildings, hills, and even bridges can cause huge signal losses. Therefore, the fundamental purpose of the topographic survey is to determine the location and number of those schools favorably situated within line-of-sight clearance of the transmitter antenna.

A good rule of thumb for estimating survey costs is to allot $50 per school. (This applies to either a small or large school

[1] There is some evidence that these signals can be "bounced" or reflected into "shadowed" areas. However, the efficacy of this technique can seldom be predicted with acceptable accuracy and actual tests are usually necessary.

district.) The survey includes site sketches, photographs, and path profiles [2] and provides additional information with which to complete FCC Form 330–P.

When the cost estimator has the survey report, he can estimate equipment needs more accurately and plan the exact number of schools that can install receivers and distribution equipment. Without such information, good cost estimating is impossible.

Where To Locate the Transmitter

One of the first decisions to be made in the engineering survey of an ITFS system is where to locate the transmitter. Several major factors influence this decision:

- Physical shape of the district to be served
- Terrain features
- Number and locations of the buildings that will receive the signals
- Availability of locations for the transmitting site and proximity to the studios
- Distance and direction to other existing ITFS systems or potential future ITFS systems.

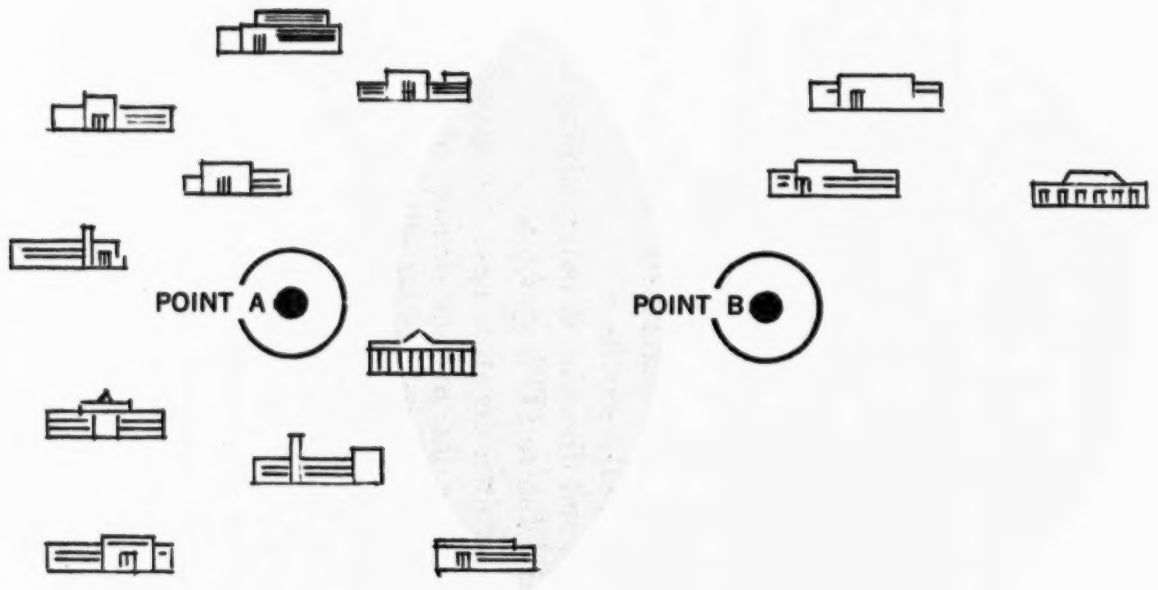
While a transmitter location near the geographic center of the area containing the highest density of schools (or other receiving locations) may seem most attractive (see **Figure IX**), other alternatives may also offer significant advantages.

The preferred location, for example, for the transmitter in a district bounded on one side by a large body of water or other uninhabited area would be on or near that boundary, because receiving antennas oriented toward the transmitter would be pointed away from sources of potential interference. Such a location would also permit concentration of the signals in half or less of the full 360-degree azimuth and provide more effective radiated power.

In the case of two small and adjacent school districts that must operate on adjacent channels, transmitter locations on the

[2] A *profile* is a scaled drawing of the optical path from transmitter to receiver showing both the terrain elevation and all critical points such as trees and buildings that may potentially interfere with the signal path.

Figure IX.
COVERAGE PATTERN



farthermost opposite boundaries would be preferable to central locations in each district because the longer path traveled by the unwanted signals would significantly reduce interference. FCC rules [Section 74.937(c)] stress the importance of geometry in the selection of the transmitter location.

A survey usually begins with the construction of a simple, small-scale (1″ : 2,000′) topographic map that shows the location of each receiving point with a small dot or circle. Such a map will lend considerable perspective to the plans for the ITFS system and enable one to "see" the best possible spot for the transmitter. Information on topographic maps in various scales is available from the Map Information Office, U.S. Geological Survey, Washington, D.C. 20242. In some larger cities, these maps are available from commercial map supply houses.

What To Anticipate at the Schools

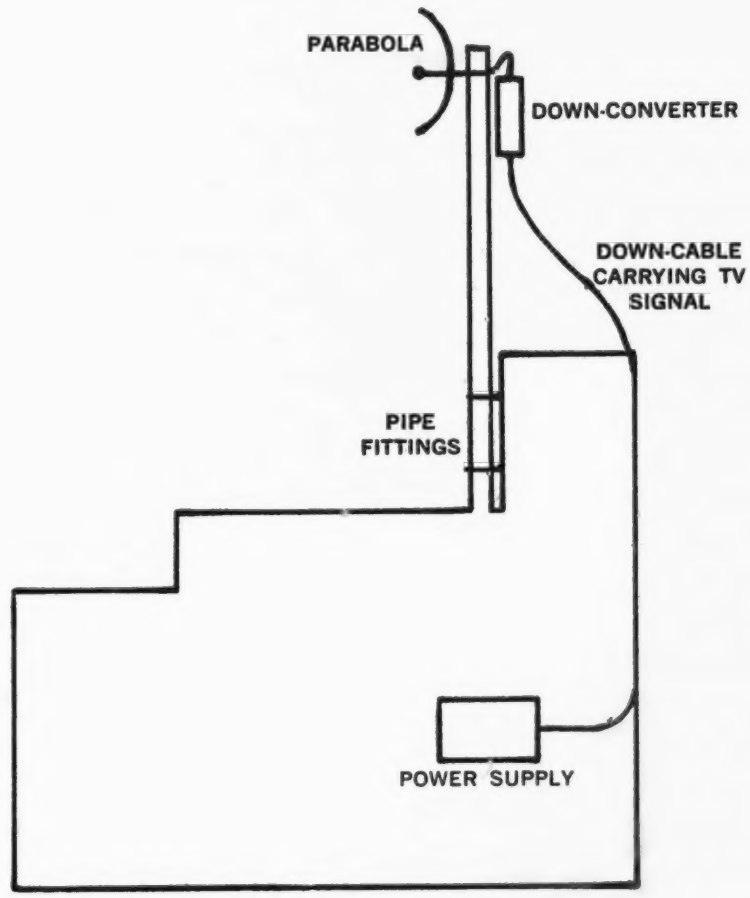
Two questions must be asked at this point: What are the installation problems? What receiving equipment is needed at each of the schools or receiving locations?

Each receiving school building will have a number of classrooms equipped with special electrical outlets that are connected by cable to the receiving converter for that school building. Each outlet must be placed close to that location in the classroom where the TV receiver(s) can be located for proper viewing by the student group. Some classrooms may need additional power outlets to avoid having unwieldy extension cords.

The internal wiring of the building itself is usually done by electricians and wiremen, who "dress" and route wires to conceal them. The distribution amplifiers and power supplies required for distributing the signals to the various classroom outlets should be located in an out-of-the-way spot, such as a vacant closet or an attic room. As a general rule, no special preparation is required beforehand at receiving locations other than to ensure that simple household-type electrical outlets are provided near the equipment and receivers. The down-converter on the rooftop or parapet obtains power from its associated power supply unit inside the building. (See **Figure X.**)

Figure X.

TYPICAL INSTALLATION ON
SCHOOL BUILDING ROOF



The outside antenna and down-converter are normally mounted on a short section of three-inch pipe secured to either the parapet or rooftop by a sturdy mount. The technician will select the appropriate mounts at the time of installation.

If the receiving location is in a difficult reception area, it is sometimes necessary to erect a small TV-type mast or tower to support the receiving antenna. Rooftop towers are practical and are not a hazard, if properly installed. Tower heights come in 10-foot sections, up to 50 feet. The engineering survey will determine the most appropriate height for the installation.

TRANSMITTING EQUIPMENT COSTS

A single-channel transmitter, complete with omnidirectional antenna and including transmission line, costs approximately $15,000, installed.

Each receiving school needs a receiving antenna (usually a parabolic type or "dish"), a down-converter, and a power supply unit. A down-converter can handle signals from up to four transmitters if they are in the same channel group. It is usually necessary to provide a 110-volt, AC electrical outlet to furnish power for the down-converter power supply. On the basis of an installation cost of $1,500 per school for these items, a school district having 50 schools should budget approximately $75,000 for the receiving antennas, down-converters, and power supply units.

Sometimes, an unusually tall tower or extremely large parabola antenna is needed to bring in the picture, and installation may not be physically or economically practical. The survey will pinpoint such schools, and further survey and discussion will determine whether or not such schools should be linked by cable or temporarily dropped from consideration. Cable charges are fairly standard and average about $40 to $50 per month per mile, depending upon the location of the schools served.[3]

[3] FCC rules provide for the licensing of "repeater" stations, which may be used to "fill in" difficult reception areas. These may be "on-channel" boosters or frequency translators. Using low power and operating unattended, these devices may be less costly than cable.

STUDIO EQUIPMENT COSTS

Two major items influence the overall costs of equipping a studio—cameras and video tape recorders. Both kinds of equipment vary widely in type and in cost.

Cameras

There are two basic types of live studio cameras: *Vidicon* and *Image Orthicon.* (These terms designate the type of tube used in the camera to pick up the scene being televised.) Vidicon cameras generally cost less ($1,000 to $8,500 each) and are smaller and less expensive to operate per hour than Image Orthicon cameras. Although Vidicon cameras can produce sharp pictures, their use requires considerable attention to studio lighting to produce the best possible picture. Vidicon tubes have a life expectancy of up to 5,000 hours; a replacement tube costs about $300.

Image Orthicon cameras are more expensive ($15,000 to $20,000 each), are larger, and cost more to operate per hour than Vidicon cameras. However, they require much less attention to scene lighting and generally produce a superior picture. Image Orthicon tubes have a shorter life (1,500 hours); a replacement tube costs about $1,300 or more, depending on the type and size. Because of their lower original and operating costs, Vidicon-type cameras are usually selected by educators with limited budgets. School systems that can afford to do so buy Image Orthicon cameras.

Video Tape Recorders

There are two principal types of video tape recorders (VTR's): *helical scan,* sometimes called "slant-track," and *quadruplex,* widely used at broadcast stations. (These terms designate the physical method of recording.) Helical-scan recorders are relatively low in price ($1,000 to $9,000 each), are smaller and less expensive to operate than quadruplex recorders, and produce acceptable pictures. Many well-known makes of helical-scan recorders are available, and each produces a video tape recording that may be played back *only on*

a similar recorder of the type and manufacture of the original recording equipment. Unless school systems have the same type and make of recorder, they cannot exchange helical-scan video tapes.

Not all models of helical-scan VTR's are appropriate for 2500 MHz transmission. The FCC sets technical standards for acceptable performance characteristics, and only those helical-scan VTR's meeting these standards may be used.

Most large educational TV systems, whether broadcast or closed-circuit, use quadruplex recorders. Because of the multitude of helical scan recorders, all incompatible with each other, a given machine cannot be expected to play many tapes from other sources. If cost considerations dictate the purchase of a helical scan recorder, care should be given to choose a machine that will accommodate tapes from major program libraries or nearby cooperating systems.

Quadruplex VTR's cost from $20,000 to $70,000 each and are larger and more expensive to operate than helical-scan recorders. Their picture quality is excellent. Because the quadruplex machine system is the standard system used by open-circuit broadcasters throughout the world, any quadruplex tape can be played back on any other. Reasonably priced quadruplex VTR's are satisfactory for ITFS work.

Practically all the tapes available from the sources mentioned under "Program Planning" are quadruplex and therefore cannot be played back directly on a helical-scan recorder. Quadruplex tapes must be re-recorded (transferred) onto the appropriate make of machine and videotaped for helical-scan replay. Re-recorded quadruplex material on helical-scan video tape is now available from tape libraries.

Other Studio Equipment

Prices for outfitting a studio completely may range from $15,000 for a small, simple type of installation to $250,000 for a large, more flexible type. If funds are limited in the overall studio budget, certain equipment options may be dropped from the initial installation and added at a later date.

Other equipment costs to include in the studio budget are lighting, scenery, air conditioning, and related facilities. A relatively safe, overall figure covering these items would range from $4,000 to $5,000, depending on the elaborateness of the studio design and facilities. This figure should be added to the total budget.

As a rule, air conditioning costs approximately $1 per square foot of studio area. Studio area can also be used as a yardstick for lighting equipment costs; and, generally, studio lighting is figured at 50¢ to 75¢ per square foot. Proper lighting, however, is a must in television production and should be tailored to specific needs. Movable lighting fixtures and lamps and switching or dimmer installations can allow great functional flexibility with limited budgetary outlays.

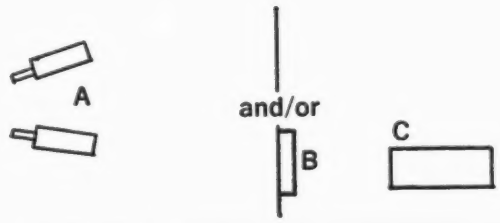
Scenery and other related facilities vary in expense; costs primarily depend on the type of productions planned. Experience in using the medium and the identification of what facilities need to be erected to meet the instructional objectives of the school will determine production plans.

At the beginning, ITFS installations should lean heavily on recorded materials. Live programing should be undertaken only when you have the budget and personnel to produce high-quality materials.

Many ITFS systems have begun successfully with only one or two helical-scan VTR's and a film chain—that is, no live production. Others have had a satisfactory beginning with only two Vidicon cameras and a switcher-fader unit—that is, solely live production. (**Figure XI** illustrates typical studios and equipment.) The educator and administrator must bear in mind that a small studio beginning should be regarded as just that—a beginning. Many educators who have allotted only a limited and underbudgeted amount for the studio sometimes become dissatisfied once the low-cost system is operating.

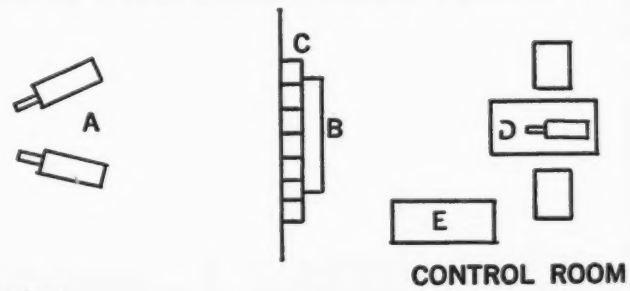
On the other hand, overbudgeting for initial studio equipment and proceeding with a large, overdesigned installation can lead to poor economical use of the system as a whole. This is particularly true in school districts with less than 20 separate school buildings.

Figure XI.
TYPICAL STUDIOS AND EQUIPMENT



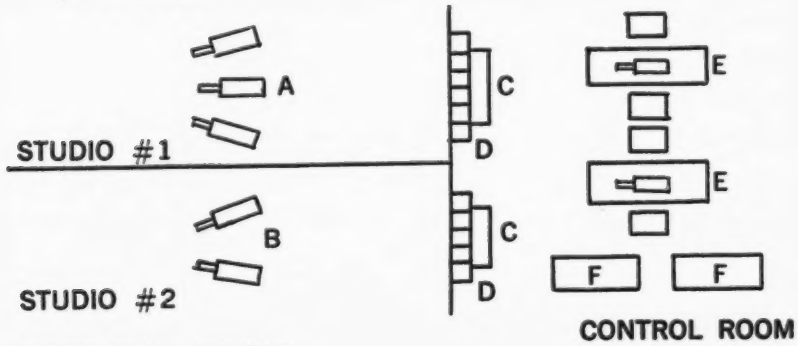
SMALL STUDIO *OR* ORIGINATION POINT

A TWO CAMERAS AND OVERHEAD LIGHTING
B AUDIO AND VIDEO SWITCHERS
C VTR AND A FILM CHAIN DISSEMINATION POTENTIAL



MEDIUM STUDIO

A VIDICON CAMERAS
B AUDIOVIDEO SWITCHER
C MONITORS
D FILM AND SLIDE PROJECTORS, CAMERA, MULTIPLEXER
E HELICAL-SCAN VTR (TYPE ACCEPTED BY FCC) (OPTIONAL)



LARGE DUAL STUDIO

A IMAGE ORTHICON CAMERAS
B VIDICON CAMERAS
C AUDIOVIDEO SWITCHERS
D MONITORS
E FILM AND SLIDE PROJECTORS, CAMERA, MULTIPLEXER
F TAPE RECORDERS

A medium-priced studio costs between $53,500 and $70,000. This includes two Vidicon cameras, a switcher, and associated equipment—approximately $25,000; for film equipment, two film projectors, a slide projector, a film camera, and multiplexer,[4] add $20,000 more. Approximately $8,500 should be budgeted for a helical-scan recorder (or about $25,000 for a quadruplex type). Approximately $10,000 more should be budgeted for installation costs for this type of studio. Such a studio installation could initially handle one or more channels and, with additional tape or film equipment, could later be expanded to a maximum of four channels.

RECEIVER AND DISTRIBUTION EQUIPMENT COSTS

Relatively accurate costs may be developed for school distribution systems by adding together separate costs for cables, amplifiers, connectors, switch plates, and similar items and by expressing the complete distribution installation in terms of *cost per outlet*. The single-receiver cost can be multiplied by the total number of individual receivers. The cost of receiver mounting brackets or stands should also be included.

Two distribution systems are generally required: a separate distribution system for the open-circuit VHF or UHF channels and a second independent system for the ITFS channels. Combined costs for both systems average $80 per classroom outlet. Receivers with stands may be estimated at $150 per set for the average 23-inch set and stand. Thus, for a school of 15 classrooms, distribution costs amount to $1,200 ($80 × 15); and classroom receiver costs will average $2,250 ($150 × 15), assuming one set per classroom. Thus, in the 15-classroom school, receiver and distribution system costs may be estimated at $3,450.

[4] A *multiplexer* is an arrangement of mirrors or lenses that enables several projectors (slide, filmstrip, 16mm) to be fed to a single camera source. Usually, the technical director determines which one of the projectors will be fed into the camera at any given time.

COLOR TELEVISION

All cost estimates in this publication are based on a black-and-white TV system. If color is planned, costs will increase considerably, primarily for studio equipment and receivers.

At present, live Image Orthicon studio color camera chains cost from $70,000 to $75,000 each; color film camera chains, from $50,000 to $55,000 each. Quadruplex recorders are necessary for color transmission and are priced at $70,000 each. Black-and-white quadruplex recorders already on hand can be converted to color use for $20,000 each. There is also a slightly increased cost for color television receiving antennas. The cost of color receivers for classrooms may be estimated at $350 per set for the average 23-inch set and stand.

Should schools consider using color television in view of its higher cost? There seems little doubt that by 1970 almost all commercial television stations, most educational TV stations, and many closed-circuit and ITFS systems will be transmitting in color.

From an educational point of view, color may enhance learning effectiveness in some areas of the curriculum. Presentations in such subjects as chemistry, biology, the fine arts, some areas of science, and the social studies may be helped by the use of color. All long-range planning should include provisions for the eventual changeover to color.

COST ESTIMATES OF A COMPLETE SYSTEM

Using the foregoing estimates, **Table 3** shows the average investment required, including maintenance, for a medium-size ITFS system. The cost of larger or smaller systems can be extrapolated from this table. Please note especially the last line in each section: the cost per pupil per year. The cost of a one- or two-channel ITFS system for 10 school buildings would be under $5 per pupil per year, or *less than 1 percent of average current school expenditures.* (The National Education Association's estimate of pupil expenditure per year is $564.)

In the case of a 20-building system, the costs per pupil per year are still lower. Even in a 20-building school system, if the number of channels were increased from two channels to four channels, the cost per pupil per year remains less than 1 percent of current expenditures.

Table 3.

AVERAGE INVESTMENTS REQUIRED FOR AN ITFS SYSTEM*

A. 10 SCHOOLS (150 CLASSROOMS—3,750 STUDENTS)

	One Channel	Two Channel	Three Channel	Four Channel
Survey	$ 500	$ 500	$ 500	$ 500
Studio equipment	45,000	45,000	60,000[a]	60,000[a]
Transmitting equipment	15,000	27,000	39,000	51,000
Receiving antenna, down-converter, etc. (9 @ $1,500 each)	13,500	13,500	13,500	13,500
Distribution system (150 rooms @ $80 each)	12,000	12,000	12,000	12,000
TV receivers and stands (150 @ $150 each)	22,500	22,500	22,500	22,500
Subtotal	108,500	120,500	147,500	159,500
Maintenance (10 years @ 5% of above cost per year)	54,250	60,250	73,750	79,750
Total cost (10 years)	$162,750	$180,750	$221,250	$239,250
Cost per year	$ 16,275	$ 18,075	$ 22,125	$ 23,925
Cost per pupil per year	$4.34	$4.82	$5.90	$6.38

* The cost of a complete ITFS color system will be appreciably more than the figures quoted above for studio equipment, transmission, and receivers. (See page 51 for a current estimate of these costs.)

B. 20 SCHOOLS (300 CLASSROOMS—7,500 STUDENTS)

	One Channel	Two Channel	Three Channel	Four Channel
Survey	$ 1,000	$ 1,000	$ 1,000	$ 1,000
Studio	45,000	45,000	60,000[a]	60,000[a]
Transmitting equipment	15,000	27,000	39,000	51,000
Receiving antenna, down-converter, etc. (19 @ $1,500 each)	28,500	28,500	28,500	28,500
Distribution system (300 classrooms @ $80 each)	24,000	24,000	24,000	24,000
TV receivers and stands (300 @ $125)[b]	37,500	37,500	37,500	37,500
Subtotal	151,000	163,000	190,000	202,000
Maintenance (10 years @ 5% of above cost per year)	75,500	81,500	95,000	101,000
Total cost (10 years)	$226,500	$244,500	$285,000	$303,000
Cost per year	$ 22,650	$ 24,450	$ 28,500	$ 30,300
Cost per pupil per year	$3.02	$3.26	$3.80	$4.04

[a] If three or four channels are operated, it is assumed that additional program origination equipment would be a necessity (one additional tape recorder or film system for each channel), approximately $10,000 to $15,000 for each additional channel. The maximum figure is used here.

[b] In larger quantities, the per unit cost of receivers and stands is less. Therefore, the $125 figure is used instead of the $150 quoted in the preceding table.

PART V. APPLICATION PROCEDURES

The licensing of stations is not difficult but does require care and accuracy in the preparation of the application forms. Qualified engineering and legal help is recommended. The applicant should first obtain copies of FCC Form 330–P, "Application for Authority To Construct or Make Changes in an Instructional Television Fixed Station."

This is a five-section application for a construction permit that must be formally approved by the FCC before a station can begin construction. The entire application is submitted in triplicate, with an extra copy of Sections I and V, which the FCC sends for comments and recommendations to the appropriate subcommittee (in the applicant's locality or geographical area) of the national Committee for the Full Development of the Instructional Television Fixed Service.

After the application is submitted to the Secretary of the Federal Communications Commission (Washington, D.C. 20554) and if it is complete and in conformity with the rules, it is formally accepted for filing and assigned a file number. An application is not acted upon until 30 days following acceptance. (During this time it is subject to objecting petitions.)

Processing of applications involves three major areas of examination and review: engineering, financial, and legal. The engineering examination verifies calculations to determine if the application conforms to the technical requirements of the Commission's rules and includes study of the geometric patterns of the proposed stations and other existing or potential

ITFS systems, as well as operational fixed systems in other services which share this band. The choice of channels is also examined to ensure that it reflects the most efficient ITFS use.

An accountant checks the financial qualifications, including adequacy of resources and matters such as discrepancies between estimated and probable actual operating costs and total costs balanced against particular costs. The financial examination is particularly concerned with verification of the source of funds; that is, whether or not the applicant has the necessary funds to construct and operate the system or has been given the authority to use the money, bonds, securities, or other financing described in the application. Attorneys determine whether the applicant is qualified under the Communications Act to become a licensee. They review technical and financial findings, check the corporate structure, and determine if there are any matters before the FCC that might affect the applicant.

When an application for a new station or for changes in an existing facility is approved, a Construction Permit (CP) is issued. The permittee has 60 days in which to begin construction and a period of six months thereafter for completion of the project. If the permittee finds that the station cannot be constructed in the specified time due to causes unforeseen at the time the application was filed, he may apply for an extension.

When construction of the facility is completed in accordance with the CP, the permittee may conduct equipment tests, following notification to the Commission. Application for the license may be submitted, accompanied by measurements of equipment performance. Following submission of a satisfactory license application, the permittee may begin program testing without further authority from the FCC, provided that the engineer in charge of the district in which the station is located and the FCC in Washington are notified (by telegram) at least two days before the beginning of such operations. In effect, this permits the CP holder to begin regular station operation and programing, although the license itself is not granted until the license application receives final approval. Do not confuse the application for the construction permit (the first step) with the application for the license (the final step), which permits the beginning of programing as outlined above.

PART VI. ITFS COMMITTEE

The rapid growth of the Instructional Television Fixed Service shortly after its establishment created a danger of saturation in many metropolitan areas. The setting up of systems without sufficient information on their potentials and operations and the development of problems and needs on local levels without adequate knowledge by the FCC soon presented difficulties. Accordingly, on October 6, 1965, at the urging of educators working with or interested in ITFS, the FCC established a national Committee for the Full Development of the Instructional Television Fixed Service.

The Committee is composed of individuals employed by local and state agencies and educational, charitable, religious, civic, social welfare, and other similar nonprofit organizations. The members of the national Committee do not represent particular organizations, but act as individuals. All geographical areas and levels and controls of education, both public and private, are represented on the Committee, as are different types of positions and educational specialties and backgrounds. The Committee's major role is to establish local, state, and regional subcommittees for the purposes of local cooperation and preplanning in order to achieve maximum efficiency in the use of available channels.

Extra copies of Sections I and V of applications for construction permits are submitted to the FCC for distribution to the appropriate subcommittee, and the comments and recommendations of that subcommittee are solicited in regard to the application.

The national Committee also provides information to potential users of the ITFS (of which this booklet is one example) and to the FCC on needs, problems, and developments in the field. The Committee—in many instances directly reflecting determinations of local, state, and regional subcommittees—makes recommendations to the FCC concerning rules and regulations pertaining to the ITFS.

Prospective users of the service should contact their appropriate regional chairman for the names of their state and local subcommittee chairmen.

Committee for the Full Development of the ITFS

Chairman: Robert E. Lee, FCC Commissioner
Executive Vice-Chairman: Robert L. Hilliard, FCC

Executive Board, 1967

Northeast Region
Chairman: Bernarr Cooper, New York State Education Department
Connecticut, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont

Southern Region
Chairman: William R. Smith, Jr., Mississippi Authority for Educational Television
Alabama, Arkansas, District of Columbia, Georgia, Florida, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, West Virginia

Midwest Region
Chairman: Robert M. Shultz, Illinois State Office of Public Instruction
Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin

Western Region
Chairman: Lawrence T. Frymire, State of California Television Commission
Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oklahoma, Oregon, Texas, Utah, Washington, Wyoming

National Groups
Chairman: Rev. John M. Culkin, S.J., Fordham University
Lewis A. Rhodes, National Association of Educational Broadcasters
Harold E. Wigren, National Education Association

CONCLUSION

This booklet has sought to clarify for the educator the nature of the ITFS system, the methods of planning for its use, the ways in which curriculum needs may be identified and possibly served through this means of TV transmission, and the physical facilities and basic equipment necessary to realize instructional and educational objectives.

Effective planning for the use of an ITFS system requires a number of steps:

- Exploration of its possibilities and limitations as compared with other methods of transmission
- Investigation of the effect it may have upon the instructional process and upon learning effectiveness
- Definition of the specific objectives the system is to serve and the conditions under which the medium will best meet these objectives
- Development of a staff.

The last-named step, development of a staff, includes the following personnel:

- A *TV coordinator*, who plans with the faculty; acts as liaison with curriculum supervisors, faculty, and administration; and assumes the overall responsibility for the effective operation of the TV system
- A *programing staff*, that procures, produces, and schedules material to meet curriculum needs
- A *technical staff*, that oversees the operation and maintenance of the studio, playback, transmitting, and receiving equipment.

Program planning and a continuous evaluation system with feedback to the TV coordinator, the curriculum supervisors, and the school administrators are vital.

The decision to use the Instructional Television Fixed Service is not to be made lightly. Other methods and systems of instructional communication may be desirable. An engineering consultant, working in close cooperation with the administration and the TV coordinator, can be helpful in evaluating which system or combination of systems can best serve the desired instructional needs.

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